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# THE **Festivus**

Vol. 52(2)

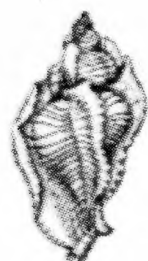
May 2020



**Review of the *Canarium urceus* Complex**  
**New Muricids from Papua New Guinea**  
**New Fossil Marginellids, and Fossil Cowries**  
**New Gastropods from the Western Atlantic**

Quarterly Publication of the San Diego Shell Club





# THE FESTIVUS

A publication of the San Diego Shell Club

Volume: 52

May 2020

ISSUE 2

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## FRONT COVER:

Live *Pusula solandri* (Gray, 1832) in a tide pool in Crystal Cove State Beach Park, Orange County, California. Photo courtesy of Sonja Huc; used with permission. (Cover artistic credit: Rex Stilwill).

## MISSION STATEMENT

The San Diego Shell Club was founded in 1961 as a non-profit organization for educational and scientific purposes. More particularly to enjoy, study and promote the conservation of Mollusca and associated marine life through lectures, club meetings and field trips. Our membership is diverse and includes beginning collectors, scientists, divers, underwater photographers and dealers.

*THE FESTIVUS* is the official quarterly publication of the San Diego Shell Club, Inc. and is issued as part of membership dues in February, May, August and November. *The Festivus* publishes articles that are peer reviewed by our volunteer Scientific Peer Review Board, as well as articles of general interest to malacologists, conchologists, and shell collectors of every level. Members of the Peer Review Board are selected to review individual articles based upon their chosen field of expertise and preference. Available by request or on our website are:

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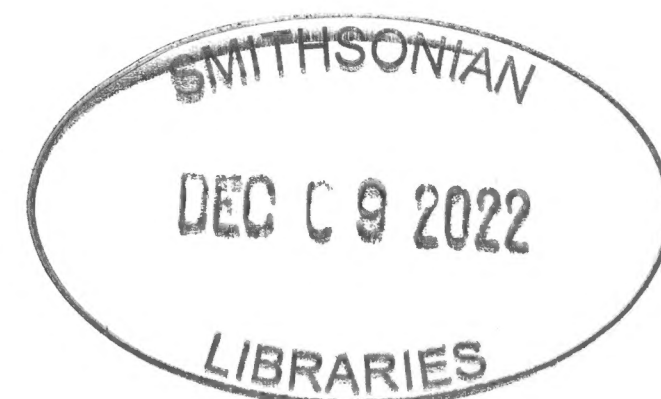
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## ***Canarium urceus* (Linné, 1758) Studies Part 1: The Recircumscription of *Strombus urceus* Linné, 1758 (Neostromboidae: Strombidae)**

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**ABSTRACT** *Strombus urceus* Linné, 1758 is a gastropod species that is one of the most variable and well documented through the centuries. However, we found the present identity of *Strombus urceus* misleading. Abbott (1960) designated the type locality, and confirmed type specimen, based on the microfiche of the Uppsala University, Museum of Evolution Zoology Section Collection, which formed the basic reference set for the *Museum S:æ R:æ M:tis Luovicæ Ulricæ* (1764), Linné's primary set of organisms from which he ordered the species in the *Systema Naturae*. This review resolves the taxonomic identity of *Strombus urceus* Linné, 1758 (= *Canarium urceus* (Linné, 1758)) through conforming the type and explicitly defining a range for that phenotype, and this then provides the basis for future work that will deal with the greater *Strombus urceus* Linné, 1758 diverse phenotypic complex and its currently assigned regional forms and varieties by the present authors.

**KEY WORDS** Strombidae, *Canarium ucreus*, phenotypic complex

### **INTRODUCTION**

There are major dilemmas facing the review of any complex group of taxa. The treatment of existing taxonomy, the ordering of precedence and the assessment of validity are challenges faced in any systematic review. This is often because early authors principally based their nomenclature on observable differences in illustrations (Linné 1758; Gmelin 1791; Röding 1798), which lacked the proper descriptive power that could help with the identification of the species. These non-illustrated works often required the hand processing of textural illustrations from earlier pictorial works, and consequently led to a great variation in the interpretation of those illustrations in the finished product between authors (Linné 1758; Gmelin 1791; Röding 1798). This can cause confusion when the species being dealt with has many morphological variations, or is close to another species in form, or the illustration of the specimen that was described is vague or even

unclear. Notwithstanding, these sometimes-enigmatic early descriptions are taxonomically valid under the applicable ICZN rules. The primary consideration as to whether a species has been deemed to be described is dependent on the level of consistency in the hand drawn illustration. An early description can only be resolved if the illustration and descriptions enable one species to be clearly distinguished from the others, and the location of the population is properly reported. The primary concern ought to be whether there is a supporting type specimen, does the overall series of illustrations show the characters that are unique to what is now considered one species, and do the illustrations have variations that are exhibited in more than one currently accepted species that could lead to confusion of the author's original intent. All these obscurities affect the determination of the true identity and complicate the revision of historically described taxa. There is requirement for an individual interpretation to be made by the reviewing



taxonomist.

Strombidae is a tropical marine family that are globally distributed and have had a great many revisions of their taxonomy through time (Hanley 1855; Sowerby 1839; Duclos 1844; Swainson 1823; Tryon 1883, 1885; Abbott 1960). Within the Strombidae, *Canarium* represents a collection of small strombs that have often confounded these reviewers, particularly in relation to the taxonomic irregularities surrounding Linné's "*urceus*" species. The "*urceus*" irregularities have been expositied by earlier workers such as Hanley (1855), Dodge (1946, 1956) and Abbott (1960). However, these revisions lacked the full gamut of evidence that technological advances provide to the modern reviewer, such as access to rare literature online, rapid communications between institutions, and the ability to draw on material held in collections world-wide with ease from the comfort of a desk. Therefore, where once the taxonomic complexity to determine the meaning of what is "*urceus*" led to a capitulation into either a belief of insolvability, or a tactical resolution to enable taxonomic continuity; both of which are without a mindset of absolute correctiveness (Dodge 1946; Abbott 1960). Therefore, this recircumscription seeks to bring a satisfactory resolution to this taxonomic conundrum.

While *Canarium urceus* (Linné, 1758) has challenged taxonomists through the centuries, and remains an enigma up to today in terms of the understanding of the relationships between the distinctive regional forms that appear to be aggregated in certain regions of the Indo-Pacific, for example the central Philippines. It is this aggregation of what could be definable and distinctive forms, which has led to the reluctance of many taxonomists to recognize the various regional names that have been historically erected (Schumacher 1817; Anton 1939; Duclos 1844; Dodge 1946).

*Canarium urceus* can be considered a model species as it also meets the five rationales for a species in need of revision (Schlick-Steiner *et al.* 2010, p. 429): 1) **Long standing taxonomic**

**dispute:** the understanding of what Linné intended to be "*urceus*" has been debated for over 150 years with conclusions ranging from it being invalid to the now broad inclusivity of a large range of phenotypes, often with distinct regional forms (Hanley 1855; Dodge 1946, 1956; Abbott 1960); 2) **Ambiguous delimitation in morphology based on primary exploration:** the distinctive regional forms and high degree of variability has led to much confusion of the true nature of the species resulting in both lumping and splitting of the complex based on the personal nuanced explanation of the taxonomist (Link 1807; Schumacher 1817; Wood 1828; Anton 1839; Watson 1885; Dodge 1946); 3) **Pronounced life history variability or broad geographic or ecological space occupied by nominal species:** while little is known of the variability in life history across the range of *C. urceus*, it has a wide range from the west coast of Thailand through to the central South Pacific, with many regions acting as unique disconnected refugia glacial maxima, or having stable island-based populations that have largely been free of the global sea-level upheavals through time; 4) **Occupies biodiversity hotspots:** the range of *C. urceus* occupies the central Indo-Pacific, which is universally recognised for its concentration of marine diversity and complex evolutionary history (Santini and Winterbottom 2002; Spalding *et al.* 2007; Carpenter *et al.* 2011; Borsa *et al.* 2016; Kulbicki *et al.* 2013; Veron *et al.* 2015; Yang *et al.* 2016; Wainwright *et al.* 2018); and 5) **Outstanding importance of organisms to progress in other fields:** resolving the phylogeography and taxonomy will help shape our understanding of the broader evolutionary history that has given rise to the biodiversity of the Indo-Pacific through provision of new evidence for radiation patterns and biogeographic dispersal influences on marine organisms and, in particular, molluscs.

To address historical methodological failing, it is necessary to examine the complete type records, and review the collective assumptions and errors that have been applied to the determinations of what is "*urceus*". These assumptions and errors may be in terms of



failure to recognise the duplicity of the Linnaean types, often only having observed one and not the other, or reflect a taxonomic imperative to enable the completion of a broader revision (Hanley 1855; Dodge 1956; Abbott 1960), or assigning type material and locality based on an acquiescence to the taxonomic understanding of what “*urceus*” is at that time, rather than what it ought to be (Abbott 1960).

This review takes the first step in resolving the taxonomic conundrum that is *Strombus urceus* Linné, 1758 (= *Canarium urceus* (Linné, 1758)) through identifying the type and explicitly defining a range for that phenotype by first principles. This is achieved by bringing together the physical type material and lectotypes to provide a sound resolution to the taxonomical enigma of what Linné’s (1758, 1764, 1767) intended when describing “*urceus*”, and to review its synonymy in the context of modern systematic understanding. Future work will deal with what constitutes the greater *Strombus urceus* Linné, 1758 diverse phenotypic complex and all its currently assigned regional forms and varieties.

## METHODS

This type revision involved two primary steps. The first step comprised the obtaining of images of the type material held in two Linnaean collections linked to *C. urceus*; Uppsala University Museum of Evolution Zoology Section no. 685, MLU, no. 288 and no. 1225 a-e; and the Linnaean Society of London box LSL. 440, Dance label: P-Z 0010875. The second step involved a complete examination of each of the iconotypes listed under “*urceus*” in the *Systema Naturae* editions (Linné 1758, 1764, 1767; Gmelin 1791), as well as the translation and examination of the descriptive text that accompanied these references. The type specimens and iconotypes were then identified and classified, with species level identification based on the current accepted taxonomy (Abbott 1960, WoRMS: [www.marinespecies.org](http://www.marinespecies.org)). After this identification process, the holotype was identified from the Uppsala University Museum

of Evolution Zoology (Abbott 1960). Once identified, the type was compared to a series of “*urceus*” specimens from across its known range. The type locality was then corrected to the region where the phenotype represented a form consistent with the type morphology.

## ABBREVIATIONS

LSC - Linnaean Collection of the Linnaean Society of London

MLU - Museum Ludovice Ulricae

SMC - Stephen Maxwell Collection

UZM - Uppsala University Museum of Evolution Zoology Section

## SYSTEMATICS

Phylum	Mollusca Linné, 1758
Superorder	Caenogastropoda Cuvier, 1797
Order	Sorbeoconcha Ponder & Lindberg, 1987
Superfamily	Stromboidea Rafinesque, 1815
Epifamily	Neostromboidae Maxwell, Dekkers, Rymer & Congdon, 2019

### Family Strombidae Rafinesque, 1815

**Type.** The type genus for Strombidae is *Strombus* Linné, 1758 (type: *Strombus pugilis* Linné, 1758).

**Diagnosis.** Shell with thickened and flaring outer lip on maturation, typically with an anterior notch on the outer lip. Eyes are located on the end of peduncles, which have the cephalic tentacles attached at the distal ends (Abbott 1960; Walls 1980; Bandel 2007; Maxwell *et al.* 2019).

### Genus *Canarium* Schumacher, 1817

**Type.** The type species is *Strombus urceus* Linné, 1758.

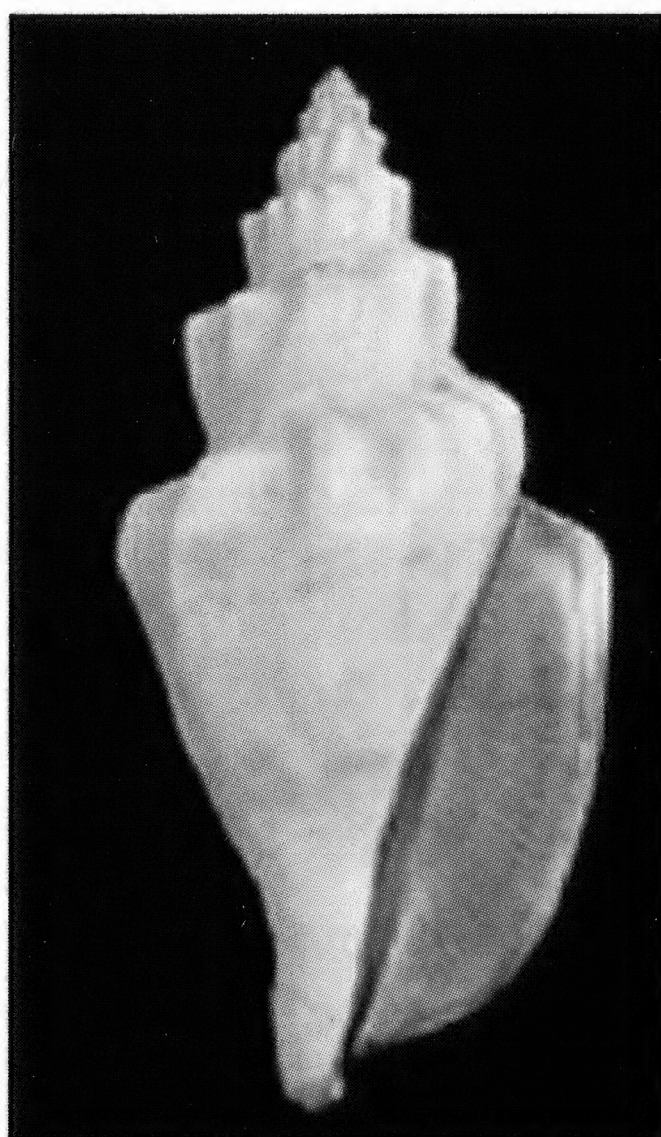
**Diagnosis.** Shell small and robust. Columella well defined. Outer lip not flared, but typically thickened, with no spines or protuberances. Stromboidal notch well developed. Aperture finely lirate in most taxa. Spire ribbed, although this may be reduced or rudimentary. Apex of



spire acute. Shoulder of body whorl typically with knobs. There is a high degree of variability in colour and form within the genus. Rachadian tooth with five cusps, middle largest, laterals with basal peg. Operculum with numerous well-developed serrations.

### *Canarium urceus* (Linné, 1758)

**Type.** Type: UZM - *Strombus urceus* lot no. 685 (Linné 1767, *Museum S:æ R:æ M:tis Luovicæ Ulricæ*, n. 288), selected by Abbott (1960, p. 66) based on image no. 300 on the Microfiche of that collection. The neotype is slightly juvenile which is reflected in the development and colouration of the aperture (Figure 1). Linné described the species in 1758, but it was not until the Linné redescription in 1764 that reference was made to specimens in his working material.



**Figure 1.** The Linnaean assigned type for “urceus”: Neotype - Uppsala University Museum of Evolution Zoology Section no. 685 (= *C. urceus*) MLU. no. 288, (63 mm).

**Type Locality.** The type locality designated as Cebu Island, Philippines by Abbott (1960, p. 66) is rejected and the type locality is re-designated as Singapore. This re-designation of the type to Singapore reflects the shells from the eastern population to which the type specimen most closely resembles, and is in congruence with the distribution given by Gmelin (1791).

### Historical Synonymy.

#### *Systema Naturae*

1758 *Strombus urceus* Linné, *Systema Naturae*, 10th edition, p. 745, no. 440. The name “urceus” appears in the Linné (1758) *Systema Naturae* as no. 440 with a description that consists of three clauses: *S. testæ labro attenuato retuso brevi striato* [The shell lip diminished, recurved with short striations], *ventre spiraque plicato-nodoso* [the spire and ventral body whorl plicated and nodulated], *apertura bilabiata inerni* [aperture with two lips and no armature (translations SM)]. The first clause describes the general shape: a shell that does not have the expanded outer-lip, is recurved and the outer lip lirated, this characteristic is shared by many in the genera *Canarium*, particularly *C. erythrinum*, *C. labiatum*, *C. mutabile* and *C. urceus*. However, it is only with *C. urceus* that we find the lirations short and diminished. The second clause implies a plicate and nodulated spire and body whorl. There are three members of the *Canarium* that fit into this description *C. erythrinum*, *C. labiatum* and *C. urceus*. The third clause seeks to separate this species from the similar *Tridentarius dentatus*, which shared similar features used to describe “urceus” but has distinct serrations on the outer lip lacking in *C. urceus*. Furthermore, added to this description are three lectotype citations. First, “Rumph. Mus. t. 37, f. T”, or Rumphius (1705) *Thesaurus Imaginum Piscium Testaceorum; Conchylia, et Mineralia*, plate 37, figure T, an image of *C. labiatum* (Figure 2). The second reference is to “Pet. Gaz. t. 98, f. 19” refers to Petiver (1712) *Gazophylactium Nature et Artis*, plate 98, figure 19, which I have not been able to locate on the plate as the figure numbers do not extend past figure 18. However, figure 14c is *C. labiatum*, and similar to the Rumphius illustration cited (Figure 2). Furthermore, the other Strombids



illustrated are not members of the clade *Canarium* but rather fall within *Doxander*, *Laeviostrombus*, and *Conomurex*. The third citation that Linné provides is “Gualt. Test. t. 32, f. G”, or Gualtieri (1742) *Index Testarum Conchyliorum*, Plate 32, figure G, which is *Ministrostrombus minimus* (Linné, 1771).

- 1764 *Strombus urceus* Linné, *Museum S:æ R:æ M:tis Luovicæ Ulricæ*, p. 624, no. 288 (the type designate). The definition provided by Linné (1764) in the *Museum Ludovicæ Ulricæ* provides a more detailed description of the taxa than contained in the *Systema Naturæ* 10th edition (Linné 1758). While citing and repeating the same description as found in the *Systema Naturæ* 10th edition, Linné (1767) and further adds to the description in four sections: *TESTA facie & habitu antecedentium quatour; dorso nodis 3 s. 4, compressis* [Shell ventral face similar in ornamentation to earlier coiling; dorsal knobs three or four and compressed]; *SPIRA testa brevior, plicato-subnodosa* [Shell spire short, with plications that have a small nodule]; *LABIUM exterius dorso elevatum, transverse striatum – internius reflexum and adnatum* [The outerlip is raised from the dorsum, with transverse striations – innerlip reflexed and blubiform]; *FAUX utrinque striata* [Aperture sides striated]. This additional description clearly indicates a shell with three or four dorsal knobs and a ventral body whorl that is similar to the spire, both characteristics of which are indicative of *C. labiatum*. Two illustrative references were provided. These two, Rumphius (1705, 1711) and Gualtieri (1742), are the same offered in the *Systema Naturæ* 10th edition (Linné 1758) (Figure 2). However, the *Museum Ludovicæ Ulricæ* omits the Petiver (1712) *Gazophylactium Nature et Artis* reference found in the *Systema Naturæ* 10th edition (Linné 1758). From the additional description and refined reference list, it can be deduced that Linné had *C. labiatum* as the most probable taxon

intended when writing this description and matched the series of specimens in Uppsala University Museum of Evolution Zoology Section (no. 1225a-e; Figure 3)

- 1767 *Strombus urceus* Linné, *Systema Naturæ* 12th edition, p. 1212, no. 512. The name “*urceus*” appears in the Linné (1767) *Systema Naturæ* as no. 512, with same description provides in the 10th edition (Linné 1758). Linné (1767) also provides an additional reference to the “M.L.U. p. 624, n. 288”, the *Museum Ludovicæ Ulricæ* (Linné 1764). The *Museum Ludovicæ Ulricæ* includes a more expanded descriptive text of “*urceus*” than is contained in this repeated 10th edition text (Linné 1758, 1764). Petiver (1712) *Gazophylactium Nature et Artis* is again reinstated after an absence in the *Museum Ludovicæ Ulricæ* (Linné 1764). As well as the three references provided in 1758, a further five more illustrative examples are cited and all drawn from “Seb. Mus. 3” or Seba (1758) *Locupletissimi Rerum Naturalium Thesauri*, III. Two representatives are drawn from plate 60, figs. 28 and 29. The Seba (1758) figure 28 is an example of *C. klineorum* (Abbott, 1960) while figure 29 is *C. labiatum* (Figure 2). A further three more illustrations are drawn from Seba (1758): plate 62, figures 41, 45 and 47, all of which illustrate examples of *C. labiatum*.
- 1791 *Strombus urceus* Gmelin, *Systema Naturæ*, 13th edn., p. 3518; no. 29. The name “*urceus*” appears in the Gmelin (1791) *Systema Naturæ* as no. 29, with same description provided in the 10th edition (Linné 1758). However, Gmelin (1791) extensively expands the list of references and highlights eight forms, while the main textual references contain a mixture of *C. labiatum*, *C. urceus* and *C. mutabile* (Figure 2). Gmelin (1791) in recognising these eight forms highlights the growing awareness of morphological differences within the growing “*urceus*” aggregation. More importantly, the forms represent two species for the most part *C. mutabilie* and *C. labiatum* indicating a



move to isolate what is now *C. urceus* as the species intended as species no. 29 of Gmelin (1791). There are three groups within the Gmelin (1791) *C. urceus*: first the forms that contain a mixed species composition form  $\alpha$  which contains both *C. mutabile* and *C. urceus*; second forms  $\beta$ ,  $\delta$  and  $\eta$  that illustrate *C. mutabile*; and third forms  $\gamma$ ,  $\epsilon$ ,  $\zeta$  and  $\theta$  which show representations of *C. labiatum* (Figure 2).

### Post Systema Naturae

- 1758 *Canarium urceus* Linné  
 = *Strombus* var. *urceus* Linné – Kiener, 1843, p. 60, pl. 30, fig. 3.  
 = *Strombus* (*Strombidea*) *urceus* Linné – Chenu 1859, p. 257, fig. 1606.  
 = *Strombus urceus* Linné – Reeve 1851, pl. 11, spc. 24c. Reeve 1860, p. 94. Hanley 1860, p. 74. Abbott and Dance 1982, p. 77.  
 = *Strombus* (*Canarium*) *urceus* Linné – Tryon 1885, p. 118, pl. 6, fig. 65. Bandel 2007, p. 150, fig. 19A.  
 = *Canarium urceus* Linné – De Bruyne 2003, pp. 91 and 92.
- 1777 *Alata canarium muricatum* Martini, p. 98, pl. 78, fig. 803; this image has the overall shape, shell colouration shell, and aperture associated with *C. ustulatum* from the continental Asian coast. The accompanying text to this illustration contained a mixture references that include *C. urceus*, *C. mutabile* and *C. labiatum*.  
 = *Strombus* (*Canarium*) *muricatus* Martini – Horst and Schepman 1908, p. 218. Adam and Leloup 1938, p. 114.  
 = *Strombus* (*Canarium*) *muricatus* Watson 1885, p. 417. Wagner and Abbott 1978, p. 09-655. Adam and Leloup 1938, p. 114. Abbott 1960, p. 65.  
 = *Strombus muricatus* Martini - Beets 1950, p. 244. = *Strombus muricatus* Watson – Walls 1980, p. 189.
- 1778 *Strombus urceus* Born, p. 281. Born (1778) erred in citing “Linn. S. N. 312” (= *Cypraea moneta* Linné, 1758). The references that Born (1778) used, that

Linné (1758, 1767) overlooked were in part incorporated into Gmelin (1791). These references are an aggregation of many now established species including: *C. klineorum*, *C. urceus*, *C. labiatum* and *C. mutabile* following the synonymy of Linné (1758, 1767).

- 1798 *Lambis urceus* Gmelin – Röding, p. 63, no. 807. Röding (1798) provided four lectotypes drawn from Martini's (1777): the first, pl. 78, f. 803 (= *C. urceus*); the second, pl. 78, f. 806 which is the dorsal view of *C. labiatum*; and figures 804-805 were used to define Röding's (1798) sp. 23 *Lambis labiata* (= *C. labiatum*).
- 1807 *Lambis urceus* Linn. Gm., – Link, p. 108. Link (1807) listed Gmelin (1791) species no. 3518 (= *C. urceus*), and followed Röding's (1798) taxonomy with the use of the genus *Lambis* and Link (1807) cited Martini pl. 78, fig. 805 (= *C. labiatum*). Link (1807) also described *L. reticulata* Link, 1807 and provided Martini pl. 77 fig. 806 (= *C. labiatum*).
- 1817 *Canarium ustulatum* Schumacher, p. 219. Schumacher (1817) cites two references to support his species: “Martin. 3. pag. 98 Tab.78. fig. 803.805”. Figure 803 is the *C. urceus ustulatum* of modern authors (Abbott 1960), while 805 is considered *C. labiatum* and was one of Röding (1798) types for that species. Schumacher (1817) recognised that description and references to “*urceus*” of Linne (1758) was best suited to the *C. labiatum*, and that therefore, what is now considered *C. urceus* was deemed an invalid name. Through time, *C. urceus ustulatum* has grown to be associated with specimens of “*urceus*” with a black aperture due to the use of the Martini fig. 803 reference (Schumacher 1817). This feature is also shared by a significant cline and the name has often been associated with shells from the eastern Asian continental coast, which is reflective of the Gmelin (1791).  
 = *Strombus urceus* form *ustulatus* Linné – Abbott 1960, pl. 20, fig. 29.
- 1844 *Strombus dentatus* Duclos in Chenu, pl. 4 figs. 8 and 9.



**Diagnosis.** The shell is elongated and fusiform and may appear biconic. The spire and body whorl have a distinctive rounded nodulated shoulder, that may become acute towards the anterior of the shell as the nodulation become finer, more acute and denser. The anterior canal is often well formed and acute in nature, being slightly reflected dorsally. The posterior of the body whorl is stained, and this staining continues to the dorsum, where it remains along the outerlip marginal fold and onto the dorsal whorl proper. The spire is always nodulated, with the knobs varying from acute in some populations to more rounded and less pronounced in others. The aperture is margined in all cases with dark staining. The inner aperture with dark lirations over a rosy white base colour. The columella is midnight black, sometimes with some traces of deep plum that flush the posterior. The lirations of the columella while present, are indistinct.

**Distribution.** Locality Records: *China* (Abbott 1960); Hong Kong Rocky Harbour, Tai She Wan (Abbott 1960). *Thailand* Bandon Bight (Abbott 1960); Koh Chang (Abbott 1960); Bangbert Bay (Abbott 1960); Hualpa Island (Abbott 1960); Koh Samet (Abbott 1960); Koh Samui (Abbott 1960); Koh Tao (Abbott 1960). *Singapore* (Chim *et al.*, 2009); Tanah Merah Besar (Abbott 1960). *Malaysia* Pankor Laut (Johnson, 1964); Jesselton North Borneo (Saul 1962); and Merambong Shoal, Johor Straits (Cob *et al.* 2009).

**Material Examined.** Singapore: Tanah Merah (53 mm, Trevor and Marguerite Collection); Changi Beach (49.7 mm, Stephen Maxwell Collection no. U1.001; 53.7 mm, SMC no. U1.002); Pulau Islands (48.2 mm, SMC no. U1.003; 48.5 mm, SMC no. U1.004). Malaysia: Tioman Island (40.3 mm, SMC no. U1.005), Rawa Island (30.9 mm, SMC no. U1.006; 31.6 mm, SMC no. U1.006; 33.2 mm, SMC no. U1.008). East Thailand: South of Pan Phé (43.5 mm, SMC no. U1.009; 42.7 mm, SMC no. U1.010; 41.5 mm, SMC no. U1.011; 40.1 mm, SMC no. U1.012).

## DISCUSSION

The “*urceus*” type material is contained in two Linnaean collections, the Linnaean Collection of the Linnaean Society of London (LSC), and the Linnaean collection held in the Uppsala University Museum of Evolution Zoology Section (UZM). In total there are three lots attributed to “*urceus*”: UZM – *Strombus urceus* no. 685, donated by Gustav IV (MLU, Linné 1767: No. 288, neotype) (Figure 1a), which reflects the modern understanding of *C. urceus*; LSC – *S. urceus*, box LSL. 440, Dance label: P-Z 0010875 contains a single shell (= *C. mutabile*) (Figure 3a); and UZM – *S. urceus*; no. 1225, donated by Gustav IV/Karl XIII, is a mixture of both *C. labiatum* (Röding, 1798) (3 a-d) and *C. erythrinum* (Figure 3e).

Hanley (1856, p. 275) argued that Linné intended *C. mutabile* based on the LSC, and note that the suspicious “*urceus*” of contemporary authors was not in the Linnaean Cabinet. In contrast, Abbott (1960) based his understanding of “*urceus*” on the microfiche type numbered specimen no. 300 from the UZM, which he rightly asserted illustrates Linné (1764), *Museum S:æ R:æ M:tis Luovicæ Ulricæ* n. 288, and which reflects a specimen in the broad phylotypic understanding of *Strombus urceus* (s.l.). The specimen n. 288 is an example typical of those from Singapore, a major historical trading hub of that period (Figure 4). Interestingly, evidence indicates that Linné actually owned the specimen referred to in the *Systema Naturae*: “Rumph. Mus. t. 37, f. T” (= *C. labiatum*), and is supposed to have written “bene” on that shell’s tag (Schumacher 1817). While this type duplicity may seem problematic at first, this duplicity is removed if we consider the philosophical state of current taxonomic resolution at the time Linné and Gmelin worked. Things were arranged into like kinds, with no evolutionary necessity, and all of nature was viewed as immutable and set (Linné 1758).

The collection of type species all share some distinctive similarities: all have lirations in the aperture, a varying level of spiral plication, and dorsal shoulder nodules, thus forming a natural



aggregable kind. Consequently, the choice of type by Abbott (1960) reflects not only the modern synthesis of *C. urceus* maintaining the current level of taxonomic stability, but also recognises a level of pragmatism when dealing with inclusivity and exclusivity in the context of the natural consequence of taxonomic advancement where natural kinds are reviewed and split further, such as with the erection of *C. labiatum*, *C. mutabile*, and *C. wilsoni* (Abbott, 1960).

The inclusion of *Ministrombus minimus* (Linné, 1771) resolves some of the issues in the *Systema Naturae* 10th edition of *C. urceus* where the iconography did not fit the description provided (Linné 1758), particularly with regard to the aspects of the flaring nature of the outer lip, and the lack of distinctive spire nodulations and plications. It is not unexpected that as the non-binominal literature is surveyed for subsequent editions of the *Systema Naturae*, and given this is occurring during a period of infancy in the taxonomic revisionary process, that the names contained within Linné (1758) would form the framework upon which an aggregation of close taxa would be made. This undifferentiated aggregation is reflected in the species diversity with the type collections (Figure 3). The effect of increasing diversity with this aggregation was not lost on Gmelin (1791) who clearly sought to reorder the synonymy of *C. urceus* with the recognition of eight forms within the complex representing predominately two species, *C. mutabile* and *C. labiatum* with one example each of *C. incisum* and *C. klineorum*.

## FURTHER RESEARCH

The next stage of the revision of *C. urceus* will involve a morphometric analysis of specimens from the regions within the complete range, leading to the formulation of a hypothesis on the division of the now aggregated complex against the type series circumscribed herein. This will then enable the identification of new taxa based on morphologically distinctive regional populations and forms. The robustness of these new taxa can then be tested in the third stage of the revision using molecular methodologies.

## CONCLUSION

This review deems *C. urceus* to be valid. This conclusion is based on the type material, associated literature and illustrated iconotypes. What is currently accepted as “*urceus*”, is much broader than the designated type material and the type locality designated by Abbott (1960) which is not concordant with Gmelin’s (1791) mentioned locality (Indian Ocean and Indonesia), although this is all caveated in that Linné did not distinguish between members of the *Canarium* by colour or pattern, and used “*urceus*” in terms of a chest of all small species, where at least five recognized species were incorporated under “*urceus*” by the final edition of the *Systema Naturae* (Gmelin 1791).

There is an author intent that is reflected in the increasing synonymy as the *Systema Naturae* goes through revisions from Linné (1758, 1767) to Gmelin (1791). This intent is demonstrated with clear trends in morphology evidenced in the description: first, a spire that was plicated and sub-nodulose, second, an aperture in which both sides were lirate and third, a relatively small shell, with most specimens being less than five centimetres. These early descriptions of the species best match *C. urceus*, and this species is featured in most Linnaean reference illustrations. Furthermore, there is a clear differentiation in the UZM type collection between the lot containing the single *C. urceus* (no. 685), and the mixed lot (no. 1225) of *C. labiatum* and *C. erythrinum*. This paper provides the first stage to now ground “*urceus*” in a stable phenotypic form and location which provides consistency with possible reported specimens, and in doing so paves the way for a more thorough revision of this wide ranging and variable species.

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**Figure 2.** The “urceus” Iconotypes used within the editions of the *Systema Naturae* (1758, 1767; 1791). Linné (1758, no. 440) – Rumphius (1705, 1711, 1741): (1) pl. 37, fig. T (= *C. labiatum*). Petiver (1713): (2) pl. 98, fig. 19? (14c illustrated) (= *C. labiatum*). Gualtieri (1742): (3) pl. 32, fig. G (= *Ministrombus minimus*). Linné (1767) – Seba (1758): (4) pl. 60, fig. 28 (= *C. klineorum* Abbott); (5) pl. 60, fig. 29 (= *C. labiatum*); (6) pl. 62, fig. 41 (= *C. labiatum*); (7) pl. 62, fig. 45 (= *C. labiatum*); (8) pl. 62, fig. 47 (= *C. labiatum*). Gmelin (1791) – Lister (1688): (9) pl. 857, fig. 13 (= *C. erythrinum*). Knorr (1768): (10) p. 13, fig. 5 (= *C. labiatum*?). Gualtieri (1742): (11) pl. 32, fig. E (= *C. urceus*). Valentijn (1726): (12) pl. 7, fig. 65 (= *C. urceus*). Bonanno (1684): (13) no. 144 (= *C. urceus*). Seba (1758): (14) pl. 61, fig. 24 (= *C. labiatum*); (15) pl. 61, fig. 25 (= ?); (16) pl. 61, fig. 26 (= *C. mutabile*); (17) pl. 61, fig. 27 (= *C. mutabile*); (18) pl. 61, fig. 30 (= *C. urceus*); (19) pl. 61, fig. 31 (= *C. urceus*); (20) pl. 61, fig. 57 (= *C. erythrinum*); (21) pl. 61, fig. 58 (= *C. erythrinum*); (22) pl. 61, fig. 59 (= *C. urceus*); (23) pl. 61, fig. 62 (= *C. urceus*); (24) pl. 61, fig. 63 (= *C. urceus*); (25) pl. 61, fig. 64 (= *C. urceus*); (26) pl. 61, fig. 66 (= *C. urceus*); (27) pl. 61, fig. 67 (= *C. klineorum*); (28) pl. 61, fig. 68 (= *C. labiatum*); (29) pl. 62, fig. 46 (= *C. labiatum*). Gottwald (1714): (30) pl. 28, fig. 193 (= *C. labiatum*); (31) pl. 28, fig. 194 a (= *C. labiatum*); (32) pl. 28, fig. 196 a (= *C. urceus*); (33) pl. 28, fig. 196 b (= *C. urceus*); (34) pl. 28, fig. 196 c (= *C. urceus*); (35) pl. 28, fig. 196 d (= *C. urceus*); (36) pl. 28, fig. 197 (= *C. urceus*); (37) pl. 28, fig. 198 a (= *C. urceus*); (38) pl. 28, fig. 198 b (= *C. urceus*); (39) pl. 28, fig. 198 c (= *C. erythrinum*?); (40) pl. 28, fig. 198 d (= *C. labiatum*); (41) pl. 28, f. 198 e (= *C. labiatum*). Martini (1777): (42) pl. 78, fig. 803 (= *C. urceus*); (43) pl. 78, fig. 804 (= *C. urceus*); (44) pl. 78, fig. 805 (= *C. urceus*); (45) pl. 78, fig. 806 (= *C. labiatum*). Gmelin (1791) forms – α – Gottwald (1714): (46) pl. 28, fig. 194b (= *C. mutabile*). Martini (1777): (47) pl. 80, fig. 870 (= *C. urceus* juvenile). β – Rumphius (1705, 1711, 1741): (48) pl. 37, fig. W (= *C. mutabile*). γ – Seba (1758): (49) pl. 61, fig. 28 (= *C. labiatum*); (50) pl. 61, fig. 29 (= *C. labiatum*); (51) pl. 61, fig. 36 (= *C. labiatum*); (52) pl. 61, fig. 37 (= *C. labiatum*). δ – Seba (1758): (53) pl. 61, fig. 32 (= *C. mutabile*); (54) pl. 61, fig. 33 (= *C. mutabile*). ε – Seba (1758): (55) pl. 61, fig. 35 (= *C. labiatum*). ζ – Seba (1758): (56) pl. 61, fig. 38 (= *C. labiatum*); (57) pl. 61, fig. 39 (= *C. labiatum*). η – Seba (1758): (58) pl. 61, fig. 50 (= *C. mutabile*). θ – Seba (1758): (59) pl. 61, fig. 60 (= *C. klineorum*); (60) pl. 61, fig. 61 (= *C. labiatum*).



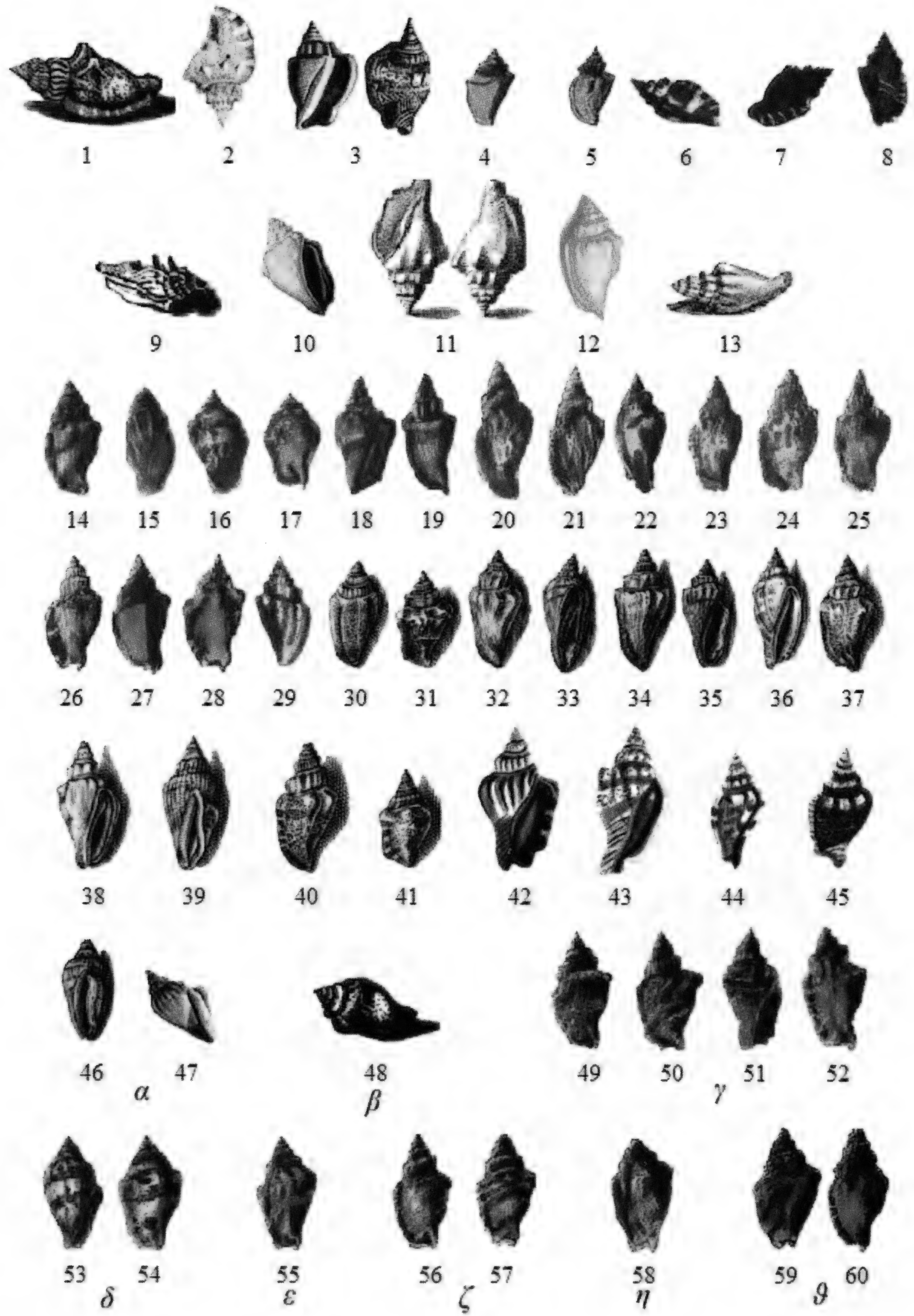


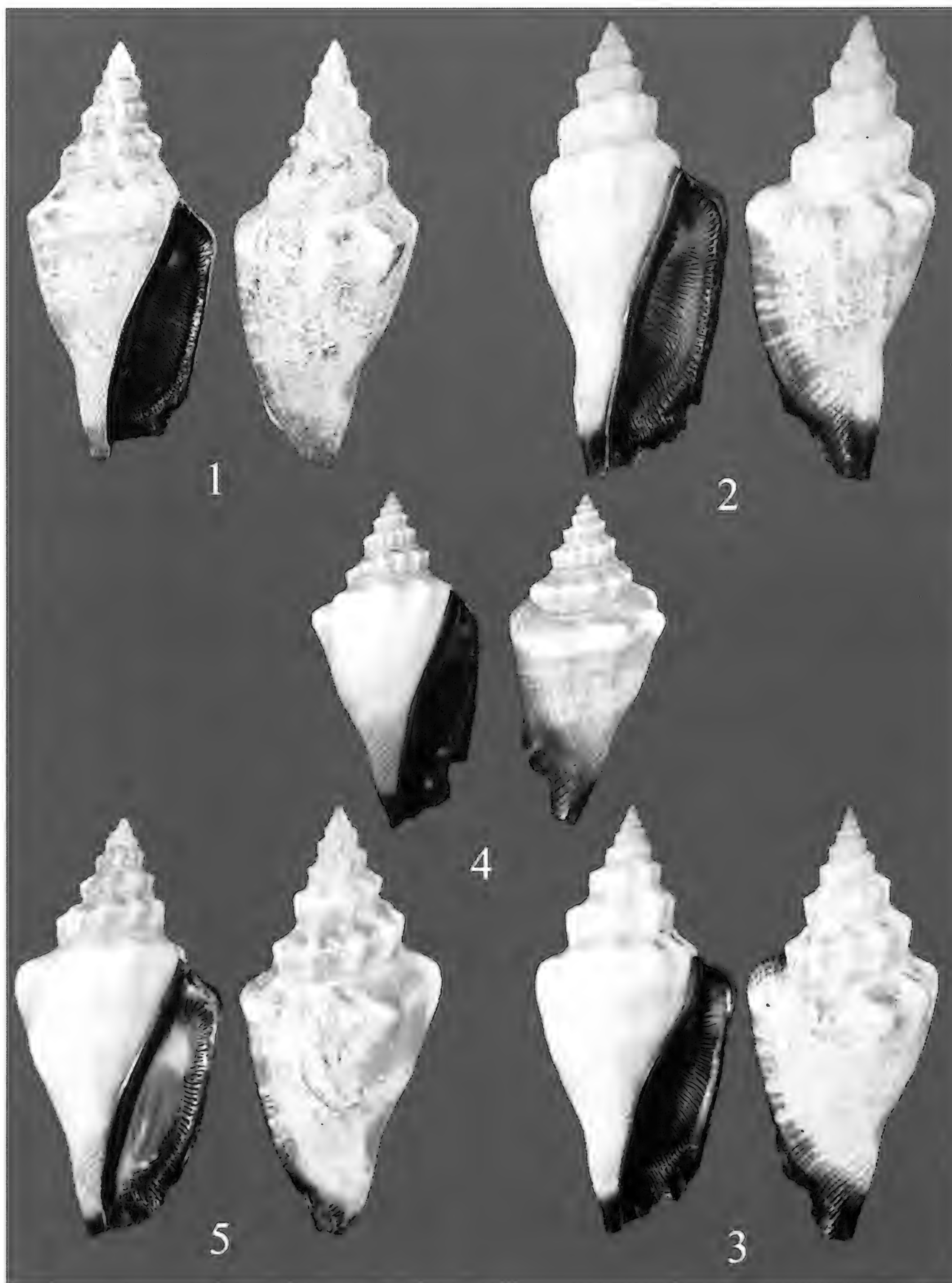
Figure 2. (figure legend on p. 124)





**Figure 3.** The Linnaean collections linked to “*urceus*” (1) Uppsala University Museum of Evolution Zoology Section no. 685, MLU. no. 288 (Holotype - *C. urceus*); (2) Uppsala University Museum of Evolution Zoology Section no. 1225a-e (= *C. labiatum* (a-d); = *C. erythrinum* (e)); (3) Linnaean Society of London box LSL.440, Dance label: P-Z 0010875 (= *C. mutabile*).





**Figure 4.** Examples of *C. urceus*: (1) Changi Beach, Singapore, 53.7 mm, Stephen Maxwell Collection no. U1.002; (2) Pulau Islands, Singapore, 48.5 mm Stephen Maxwell Collection no. U1.004; (3) Pulau Islands, Singapore, 48.2 mm, Stephen Maxwell Collection no. U1.003; (4) Rawa Island, Malaysia, 31.6 mm Stephen Maxwell Collection no. U1.006; (5) South of Pan Phé, East Thailand, 41.5mm Stephen Maxwell Collection no. U1.011.



**Contribution to the knowledge of the Muricidae (Gastropoda)  
collected during Belgian explorations in Papua New Guinea  
with the description of a new muricopsine species**

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**ABSTRACT** A new muricid species assigned to the genus *Favartia* is described from Madang Province in Papua New Guinea and is compared with similar-looking species from the Indo-West Pacific. The Muricidae species, excluding Coralliophilinae, collected during several Belgian explorations in Papua New Guinea is listed in the appendix.

**KEY WORDS** Papua New Guinea, Madang Province, Muricidae, list, *Favartia madangensis*

## INTRODUCTION

Laing Island is situated in the middle of Hansa Bay, in the western part of the Bismarck Sea, off the north coast of Papua New Guinea (4°10' 30" S and 144°52' 47" E) (Figure 1). The island is a low coral formation 850 m long and maximum 150 m wide and is the only emerged portion of a reef string aligned along a north-south axis in Hansa Bay.

A laboratory, the King Leopold III Biological Station, associated with the Free University of Brussels (Université Libre de Bruxelles - ULB), was built on the island in 1975.

The Leopold III Fund was created in 1972 to promote the exploration of nature and, in particular, to contribute to the conservation of fauna and flora. The Fund made a major contribution to the creation and functioning of this permanent biological station on Laing Island. It supported its operation until 1995 when it was closed (in part from Claereboudt *et al.* 1989).

Eighty-four muricid species, now deposited in the collections of the Royal Belgian Institute of Natural Sciences (RBINS), collected by the members operating from the biological station, have been identified (see Appendix), including one species new to science that is described in this paper. The coralliophilines have not yet been studied.

Unless otherwise stated, all the material mentioned here is deposited in the collection of the RBINS.

The new species described below is compared with a few similar species, especially two closely resembling taxa described by D'Attilio & Bertsch (1980). Both, *F. judithae* D'Attilio & Bertsch 1980 and *F. pelepili* D'Attilio & Bertsch 1980 are similar in size and form, but their spine ornamentation is invariably different. *F. judithae* having shorter, narrow, adapically bent varical spines while they are usually longer, less frondose, less upward bent and bifurcated at their distal end in *F. pelepili*. These differences have been illustrated, subsequent to the original publication, by drawings using a camera lucida



by D'Attilio (1987) and are also illustrated here with photos.

## ABBREVIATIONS

*Terminology used to describe the spiral cords and the apertural denticles* (after Merle 2001 and 2005) (Figure 3E). Terminology in parentheses: variable feature.

Convex part of teleoconch whorl and siphonal canal:

**ab**: abapical (or abapertural); **abis**: abapical infrasutural secondary cord (on subsutural ramp); **ad**: adapical (or adapertural); **adis**: adapical infrasutural secondary cord (on subsutural ramp); **ADP**: adapertural primary cord on the siphonal canal; **IP**: infrasutural primary cord (primary cord on subsutural ramp); **MP**: median primary cord on the siphonal canal; **P**: primary cord; **P1**: shoulder cord; **P2–P6**: primary cords of the convex part of the teleoconch whorl; **s**: secondary cord; **s1–s6**: secondary cords of the convex part of the

teleoconch whorl (example: s1 = secondary cord between P1 and P2; s2 = secondary cord between P2 and P3, etc.).

Aperture:

**D1 to D5**: abapical denticles; **ID**: Infrasutural denticle.

## Other abbreviations.

ad: adult shell

juv: juvenile shell

lv: live collected specimen

## DEPOSITORIES

**RBINS**: Royal Belgian Institute of Natural Sciences, Brussels, Belgium.

**MNHN**: Muséum national d'Histoire naturelle, Paris, France.

**RH**: Roland Houart, private research collection of the author, Landen, Belgium.

**SDNHM**: San Diego Natural History Museum, California, U.S.A.

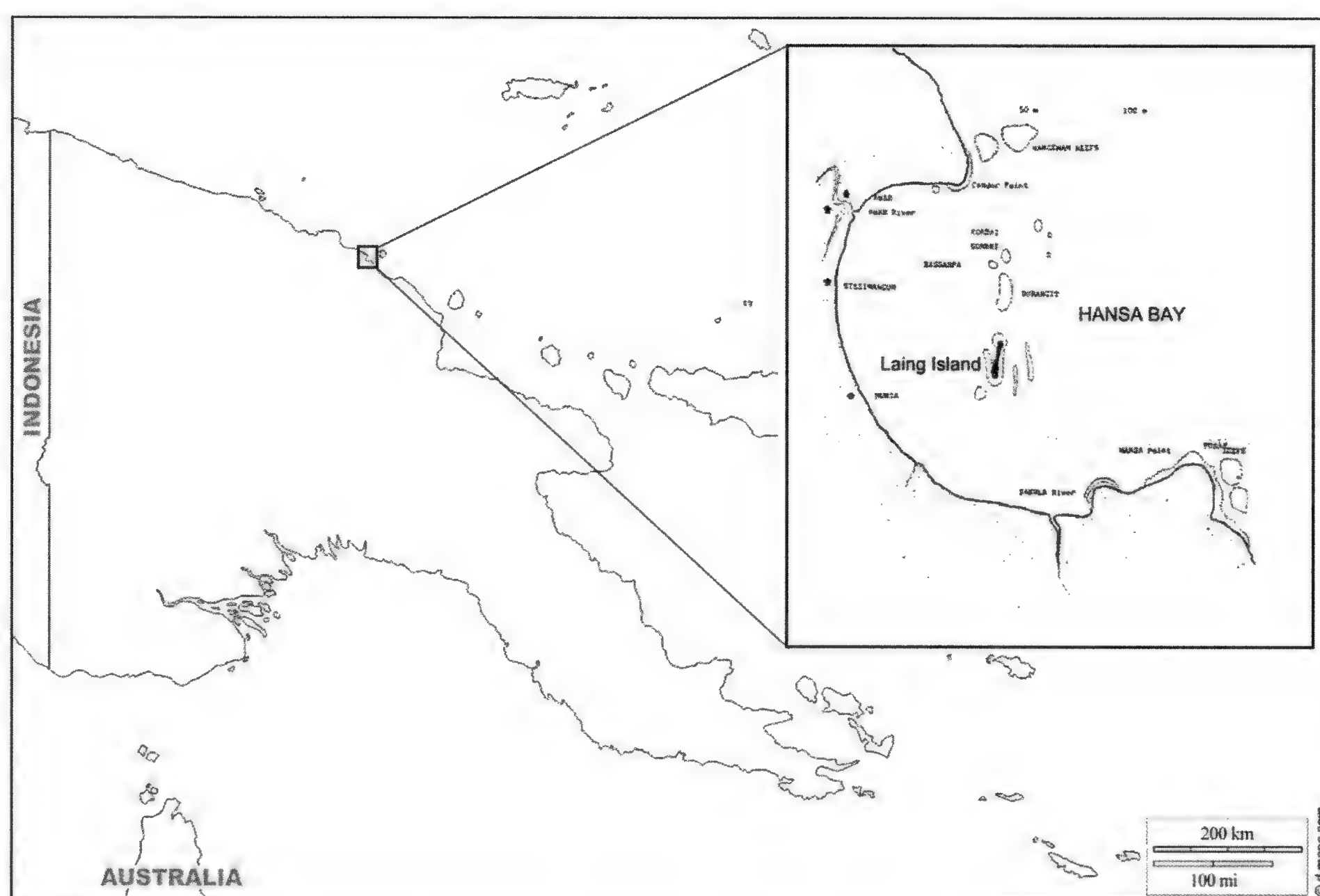


Figure 1. Map of Papua New Guinea and Laing Island Reef Complex (in part from Claereboudt *et al.* 1989).



## MATERIALS AND METHODS

**Material.** The material studied consists of the muricids collected by scientists of the RBINS and the ULB operating from the King Leopold III Biological Station in Hansa Bay, Madang Province, Papua New Guinea from 1975 to 1995.

Other material of the new species described here originates from the personal research collection of the author and from MNHN. A single, juvenile specimen was collected alive during the "Our Planet Reviewed" Papua Niugini expedition conducted by the MNHN with Pro Natura International and IRD in Papua New Guinea, from October 4 to December 26, 2012 during an intensive study of the Madang region. Another single, adult, empty shell was collected during the Santo 2006 expedition conducted by MNHN with Pro Natura International and IRD from August to December 2006 on the island of Espiritu Santo, in the Vanuatu archipelago.

Specimens of wet preserved material in RBINS were anesthetized in 3-5%  $\text{MgCl}_2$  or  $\text{MgSO}_4$  and fixed with  $\pm 4\%$  buffered formalin (pH  $\pm 8$ ) for several months. Upon arrival in RBINS, specimens were rinsed in water and transferred to  $\pm 70\%$  ether-denaturated buffered ethanol for permanent storage.

MNHN material from Papua Niugini was processed in the field specifically for molecular analysis and was microwaved to separate the animal from the shell. Tissue clips of foot tissue were preserved in 95-98% ethanol.

**Morphological analysis.** The characters used to describe shell morphology address the general aspect of the shell, its shape, size, and colour, the shape of the spire including the number and features of the protoconch and teleoconch

whorls, details of the suture and of the subsutural ramp, details of axial and spiral sculpture, the aperture, the siphonal canal, and the characters of the operculum.

The method used to determine diameter and height, and to count the number of protoconch whorls, follows Bouchet & Kantor (2004) as shown in Figure 2. Unless otherwise indicated, species description is based on the holotype and the paratypes. The bathymetric ranges given herein are the inner values of the recorded depths: the deepest minimum and the shallowest maximum (Bouchet *et al.* 2008).

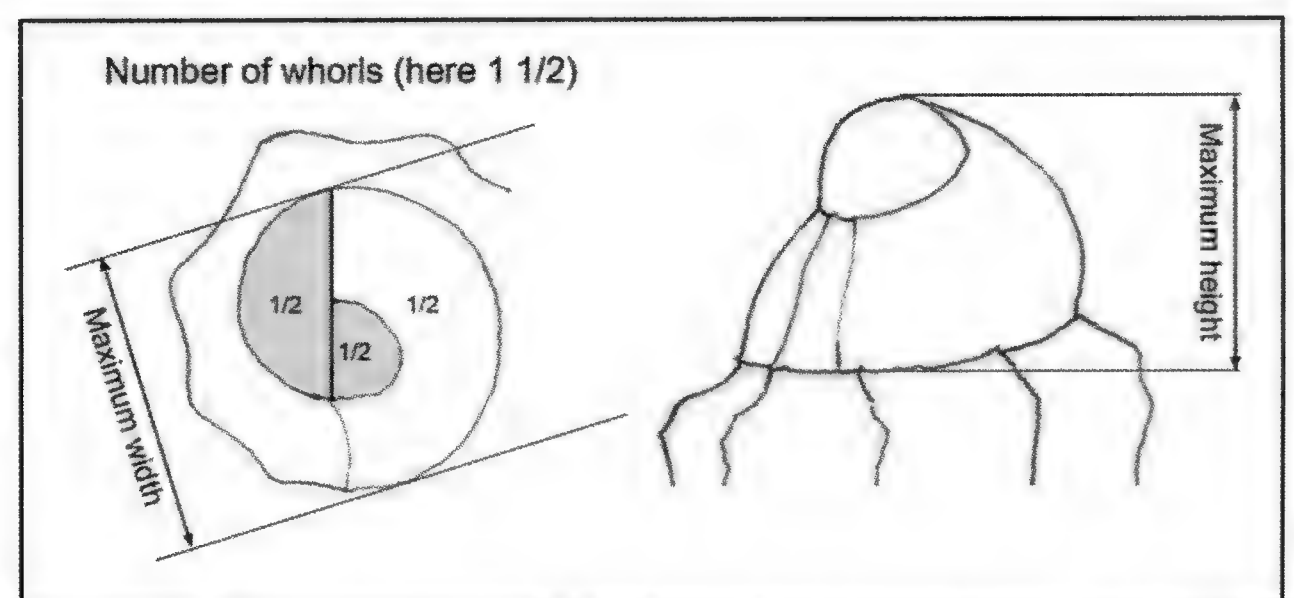


Figure 2. Measurements of the protoconch (scale bars: 500  $\mu\text{m}$ ).

## SYSTEMATICS

Family	Muricidae Rafinesque, 1815
Subfamily	Muricopsinae Radwin & D'Attilio, 1971
Genus	<i>Favartia</i> Jousseaume, 1880
Type	<i>Murex breviculus</i> Sowerby, 1834, Indo-West Pacific. (type species by original designation)

*Favartia madangensis* Houart, new species  
(Figure 3A–M)

**Description.** Shell medium-sized for the genus, up to 27.2 mm in length at maturity. Length/width ratio 1.4-1.6. Biconical, broadly ovate, lightly built, strongly spinose, squamous. Subsutural ramp broad, weakly sloping and concave.



Shell uniformly light tan or light brown. Spire high with 1.5 protoconch whorls and teleoconch up to 6 broad, convex, strongly shouldered, spinose whorls. Suture impressed, partially obscured by P3 spiral cord of previous whorl in adult specimens. Protoconch small, whorls rounded, smooth. Maximum width 650-700  $\mu\text{m}$ , height 600  $\mu\text{m}$ . Terminal lip shallow, thin, weakly curved, orthocline or weakly opisthocline. Axial sculpture of teleoconch whorl consisting of high, narrow, frondose varices; each varix with 6 short or moderately long, frondose, narrow primary spines. Shoulder spine longest. Other axial sculpture of low, narrow, almost indistinct growth lamellae. First and second teleoconch whorls with 5-9 varices, third and fourth with 5-8, penultimate 5-7, last whorl with 5 or 6 varices. Spiral sculpture of high, strong, rounded, narrow, squamous primary cords, weakly decreasing in strength abapically, topped with low, narrow, threads. First teleoconch whorl with visible P1 and P2; third to penultimate whorls with visible adis, IP, abis, P1, P2 and upper part of P3 covering suture of whorls. Last whorl with adis, IP, abis, P1, s1, P2, s2, P3, s3, P4, s4, P5, s5, P6, s6 on convex part of whorl and ADP, MP on siphonal canal. P1-P5 primary cords and spines weakly decreasing in strength abapically; P6 spine shorter and narrower. ADP and MP of same strength as P1-P5, extending as short broad, bifurcated spines. Aperture moderately large, roundly ovate. Columellar lip narrow, smooth, partially erect, a small portion adherent adapically, with weak, low parietal tooth at adapical extremity. Anal notch shallow, broad. Outer lip erect, with numerous, weak, low, narrow lirae within, corresponding to split ID, D1-D5. Siphonal canal moderately long, broad, straight, tapered adapically, dorsally recurved at tip, narrowly open, with 2 frondose ADP and MP spines. Operculum light brown, ovate, with apical nucleus in lower right. Radula unknown.

**Type material.** Papua New Guinea, Madang Province, Nagada, N of Madang, North Wongat Reef, 25 m, coral sand, stn 61, holotype RBINS I.G.26086/MT.3863, 1 lv, ad (wet), and 4 paratypes RBINS I.G.26086/MT.3864, 4 lv, juv (wet); Wongat, Mililat (11 km north of Madang), 17.5 m, on sandy bottom with Halimeda, stn 41, 1 paratype RBINS I.G.26080/MT.3865, 1 lv, ad (wet); Mililat Harbour (11 km north of Madang), small reef, 23 m, on sandy mud, stn 46, 1 paratype RBINS I.G.26080/MT.3866, 1 lv, ad (wet); Nagada, N of Madang, Natawan Reef, 25 m, sand-coral-algae, stn 50, 1 paratype RBINS I.G.26086/MT.3867, 1 lv, ad (wet); Hansa Bay, Laing Island, 1978, 2 paratypes RH, lv, ad, (dry); Madang Harbor, dredged 9 m, off small island, 1983, 1 paratype RH, lv, juv, (dry). Papua Niugini, Papua New Guinea, Madang Province, Astrolabe Bay, 05°11.8'S, 145°48.8'E, 11/11/2012, 7-15 m, stn PB12, paratype MNHN-IM-2013-11756, 1 lv, juv (wet).

**Type locality.** Papua New Guinea, Madang Province, Nagada, north of Madang, North Wongat Reef, 25 m, coral sand.

**Other material examined.** Papua New Guinea, Madang Province, Nagada, N of Madang, Tab Island, 25 m, dredge, muddy sand, stn 4, RBINS I.G.26086/INV.131208, 1 lv, juv (wet); Nagada, N of Madang, Wongat reef, 30 m, muddy sand, 30 m, 02.11.1979, stn 11, RBINS I.G.26086/INV.99281, 2 lv, ad (dry); Mililat (11 km north of Madang), 22 m, on sandy bottom, 1979, stn 38A, RBINS I.G.26080/ INV.99278, 1 lv, juv (dry); Mililat (11 km north of Madang), small reef, 22.5 m, on sandy mud, 1979, stn 40A, RBINS I.G.26080/ INV.99279, 1 lv, juv (dry); Mililat Harbour (11 km north of Madang), small reef, 25 m, on sandy mud, 1979, stn 45A, RBINS I.G.26080/ INV.99280, 1 lv, juv (dry); Mililat Harbour (11 km north of Madang), small reef, 23 m, on sandy mud, 1979, stn 46, RBINS I.G.26080/ INV.99277, 1 lv, ad (dry); Nagada,



N of Madang, Wongat Reef, 20 m, muddy sand, sponges, stn 57, RBINS I.G.26086/ INV.131211, 2 lv, juv, (wet); Nagada, N of Madang, North Wongat Reef, 25 m, coral sand, stn 63, RBINS I.G.26086/ INV.131212, 3 lv, juv (wet); Nagada, N of Madang, North Wongat Reef, 25 m, coral sand, stn 65, RBINS I.G.26086/ INV.131209, 1 lv, ad (wet). Santo 2006, Vanuatu, Espiritu Santo Island, 15°35' S, 167°14' E, 15/10/2006, 10-51 m, stn EP35, MNHN-IM-2012-11498, 1 dd, ad.

**Distribution.** Papua New Guinea, Madang Province, and Vanuatu, Espiritu Island, living at 9-30 m.

**Remarks.** *Favartia madangensis* n. sp., *F. pelepili* (D'Attilio & Bertsch, 1980) and *F. judithae* (D'Attilio & Bertsch, 1980) are three species, which morphologically are very similar, but whose shell differs by one or more very specific features, common to all the examined specimens. The geographic distribution of *F. pelepili* and *F. judithae* is Indo-West Pacific with a predominance for the Philippines, but they have not yet been reported from Papua New Guinea. However, *F. madangensis* n. sp. (MNHN-IM-2012-11498), and two juvenile specimens of *F. pelepili* (MNHN-IM-2012-1440 and MNHN-IM-2012-1552) were recorded in Vanuatu during Santo 2006 expedition.

*Favartia pelepili* (Figures 4A–H) differs from *F. madangensis* n. sp. in having the frondose spines obviously bifurcated at their extremity (Figure 4H) as opposed to usually shorter and not or very weakly bifurcated spines in *F. madangensis* n. sp. (Figure 3L). *F. pelepili* also has a less elongate shell with a comparatively lower spire, a broader shell and a single ADP spine on the siphonal canal, strongly bifurcated at its extremity compared to a higher spire and comparatively narrower shell in *F. madangensis*

n. sp. and two obvious ADP and MP spines on the siphonal canal and non-bifurcated spines. Length/width ratio, spines included, is of 1.2-1.4 in *F. pelepili* as opposed to 1.4-1.6 in *F. madangensis* n. sp.

*Favartia judithae* (Figures 4I-L; 5A-C) differs from *F. madangensis* n. sp. in having narrower, less elaborate and narrower varical spines. *F. madangensis* n. sp. also has a more elongate shell with two obvious ADP and MP spines on the siphonal canal while *F. judithae* has only one ADP spine, as does *F. pelepili*. Finally, the protoconch of *F. judithae* is also different, consisting of 2.5 narrow, globose whorls as illustrated by Myers & D'Attilio (1986), here reproduced in Figure 4K, rather than 1.5 rounded whorls in *F. madangensis* n. sp. (Figure 3M).

*Favartia balteata* (Sowerby II, 1841) (Figures 5D-F), also living around and off Papua New Guinea, differs from *F. madangensis* n. sp. in having a broader, heavier, less elongate shell with narrower primary cords, less frondose and narrower spines and more widely spaced P2 and P3 cords with an obvious s2 cord between them. It also has a comparatively shorter siphonal canal with narrower and shorter ADP and MP spines.

*Favartia cirrosa* (Hinds, 1844) (Figures 5G-I), living in the same area as *F. pelepili* and *F. judithae* and, to my knowledge, also not recorded in Papua New Guinea, is different in having a usually smaller and broader shell with a lower spire, a narrower and less sloping subsutural ramp, close-set, similarly sized P1-P6 primary spiral cords, while these are more widely spaced and the P6 cord and spine being strongly reduced in *F. madangensis* n. sp. The siphonal canal of *F. cirrosa* also bears only a single, broad, bifurcated MP spine, as opposed



to two obvious, broad ADP and MP spines in *F. madangensis* n. sp.

*Favartia voorwindei* Ponder, 1972 (Figures 5J-L), is close to *F. cirrosa* but rounder and also differing from it in having a less shouldered shell and a smaller, narrower protoconch with a different terminal lip. This species differs from *F. madangensis* n. sp. by the same characters as those which differentiate *F. cirrosa* from the latter.

*Favartia morisakii* Kuroda & Habe, 1961 (Figures 5M-O), from Japan, differs in having a smaller shell with a lower spire and a shorter siphonal canal. The primary spiral cords are narrower, more widely spaced, giving rise to short, narrow, not bifurcated spines. These cords are separated by narrow but quite obvious secondary cords rather than very narrow ones, or absent, in *F. madangensis* n. sp.

**Etymology.** *F. madangensis*: All the specimens from RBINS have been collected in the Madang Province, on the northern coast of Papua New Guinea.

## DISCUSSION

Surprisingly, no species of Aspellinae, Triterotyphinae or Typhinae, some of them usually occurring at the same depth as the other material, *i.e.* from the shoreline to approximately 40 – 45 m deep, were discovered in the examined lots.

A new *Dermomurex* species (Aspellinae) was recently described by Houart (2015) from the same area, in 22 m, during the Papua Niugini expedition, but no specimens assigned to Triterotyphinae and shallow-water Typhinae were collected during the shallow water sampling of this expedition either. That could

mean the absence or poverty of these subfamilies in the shallow waters of the Madang region.

The muricid collection of the Madang Province in the RBINS is highly representative of the shallow water muricid biodiversity of the region.

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**APPENDIX** Muricidae collected in Hansa Bay, Papua New Guinea, now housed in the Royal Belgian Institute of Natural Sciences, listed in their assigned subfamily.<sup>1</sup>

### Subfamily ERGALATAXINAE

*Cytharomorula benedicta* (Melvill & Standen, 1895)  
*Drupella cornus* (Röding, 1798)  
*Drupella fragum* (Blainville, 1832)  
*Drupella margariticola* (Broderip, 1833)  
*Drupella rugosa* (Born, 1778)  
*Lataxiena blosvillei* (Deshayes, 1832)  
*Maculotriton serriale* (Deshayes, 1834)  
*Morula (Habromorula) biconica* (Blainville, 1832)  
*Morula (Habromorula) lepida* (Houart, 1995)  
*Morula (Habromorula) striata* (Pease, 1868)  
*Morula (Morula) nodicostata* (Pease, 1868)  
*Morula (Morula) parva* (Reeve, 1845)  
*Morula (Morula) uva* (Röding, 1798)  
*Murichorda fiscella* (Gmelin, 1791)  
*Muricodrupa anaxares* (Kiener, 1836)  
*Muricodrupa fenestrata* (Blainville, 1832)  
*Orania badia* (Reeve, 1845)  
*Orania fischeriana* (Tapparone Canefri, 1882)  
*Orania gaskelli* (Melvill, 1891)  
*Orania nodosa* (Hombron & Jacquinot, 1841)  
*Orania pleurotomoides* (Reeve, 1845)  
*Pascula darrosensis* (E.A. Smith, 1884)  
*Pascula muricata* (Reeve, 1846)  
*Pascula ochrostoma* (Blainville, 1832)  
*Pascula ozeneanna* (Crosse, 1861)  
*Phyllocoma convoluta* (Broderip, 1833)  
*Spinidrupa euracantha* (A. Adams, 1853)  
*Tenguella ericius* Houart, Puillandre & Zuccon, 2019  
*Tenguella granulata* (Duclos, 1831)  
*Tenguella musiva* (Kiener, 1835)

### Subfamily MURICINAE

*Attiliosa nodulifera* (Sowerby, 1841)  
*Chicomurex laciniatus* (Sowerby, 1841)  
*Chicomurex turschi* (Houart, 1981)  
*Chicoreus (Chicoreus) ramosus* (Linnaeus, 1758)  
*Chicoreus (Triplex) axicornis* (Lamarck, 1822)  
*Chicoreus (Triplex) banksii* (Sowerby II, 1841)  
*Chicoreus (Triplex) brunneus* (Link, 1807)  
*Chicoreus (Triplex) microphyllus* (Lamarck, 1822)  
*Chicoreus (Triplex) nobilis* Shikama, 1977  
*Chicoreus (Triplex) rossiteri* (Crosse, 1872)  
*Chicoreus (Triplex) torrefactus* (Sowerby, 1841)  
*Haustellum haustellum* (Linnaeus, 1758)  
*Murex (Murex) pecten* Lightfoot, 1786

*Murex (Murex) salomonensis* Parth, 1994  
*Murex (Murex) tenuirostrum* Lamarck, 1822  
*Murex (Murex) ternispina* Lamarck, 1822  
*Naquetia cumingii* (A. Adams, 1853)  
*Naquetia triqueter* (Born, 1778)  
*Pterynotus (Pterymarchia) barclayanus* (H. Adams, 1873)  
*Pterynotus (Pterymarchia) bipinnatus* (Reeve, 1845)  
*Pterynotus (Pterymarchia) martinianus* (Röding, 1798)  
*Pterynotus (Pterymarchia) tripterus* (Born, 1778)  
*Pterynotus (Pterynotus) elongatus* (Lightfoot, 1786)  
*Pterynotus (Pterynotus) pinnatus* (Swainson, 1822)  
*Vokesimurex bantamensis* (Martin, 1895)

### Subfamily MURICOPSINAE

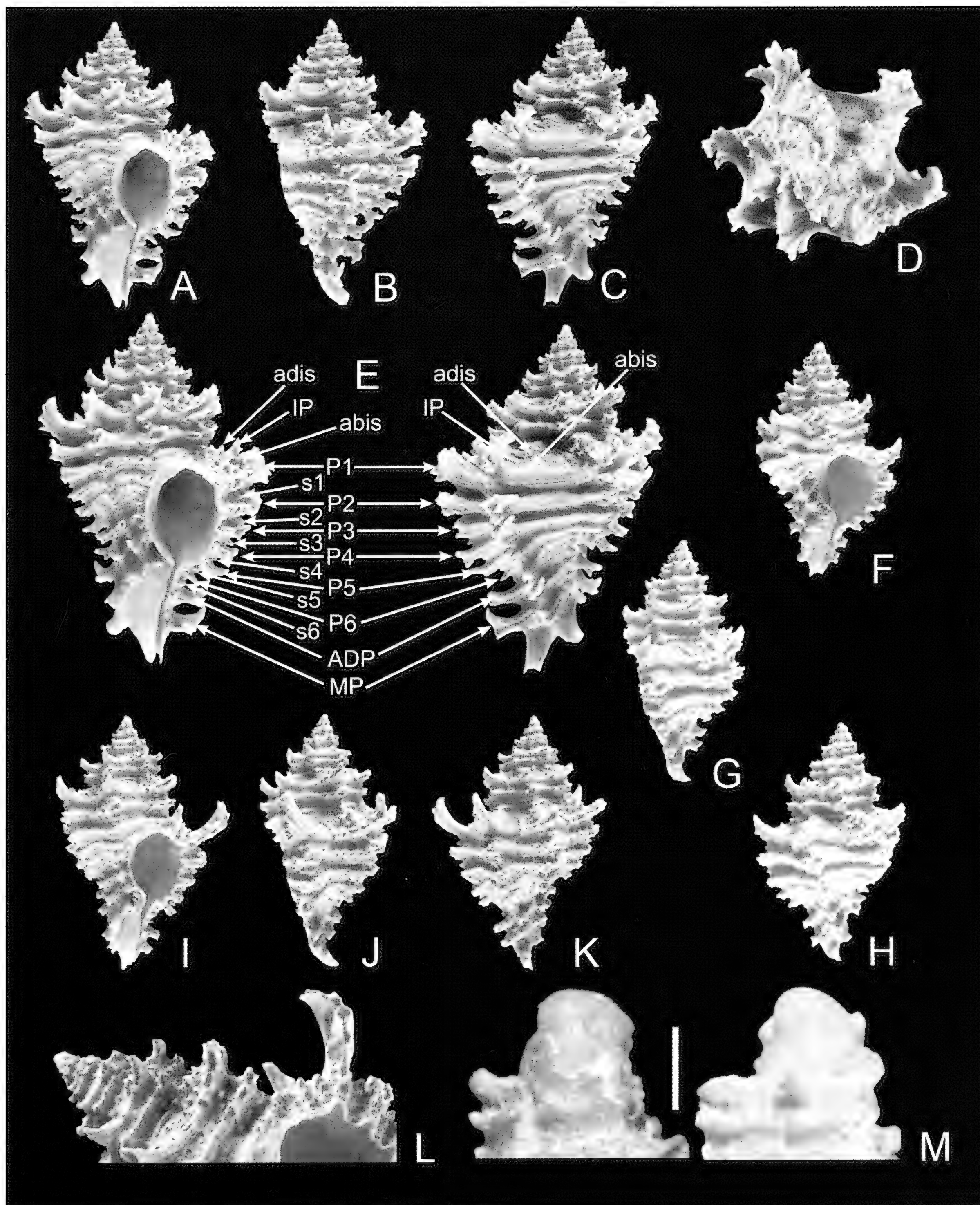
*Favartia madangensis* n. sp.  
*Favartia ponderi* Myers & D'Attilio, 1989  
*Favartia salmonea* (Melvill & Standen, 1899)  
*Favartia sykesi* (Preston, 1904)  
*Homalocantha anatomica* (Perry, 1811)  
*Homalocantha pele* (Pilsbry, 1918)  
*Homalocantha scorpio* (Linnaeus, 1758)  
*Vitularia miliaris* (Gmelin, 1791)

### Subfamily RAPANINAE

*Drupa albolabris* (Blainville, 1832)  
*Drupa clathrata* (Lamarck, 1816)  
*Drupa morum* Röding, 1798  
*Drupa ricinus* (Linnaeus, 1758)  
*Drupa rubusidaeus* Röding, 1798  
*Drupina grossularia* (Röding, 1798)  
*Mancinella alouina* (Röding, 1798)  
*Mancinella armigera* Link, 1807  
*Mancinella echinulata* (Lamarck, 1822)  
*Menathais intermedia* (Kiener, 1836)  
*Menathais tuberosa* (Röding, 1798)  
*Nassaserta* (Bruguère, 1789)  
*Neothais marginatra* (Blainville, 1832)  
*Purpura persica* (Linnaeus, 1758)  
*Semiricinula konkanensis* (Melvill, 1893)  
*Semiricinula muricoides* (Blainville, 1832)  
*Semiricinula squamosa* (Pease, 1868)  
*Semiricinula turbinoides* (Blainville, 1832)  
*Taurasia striata* (Blainville, 1832)  
*Tylothais aculeata* (Deshayes, 1844)  
*Tylothais virgata* (Dillwyn, 1817)

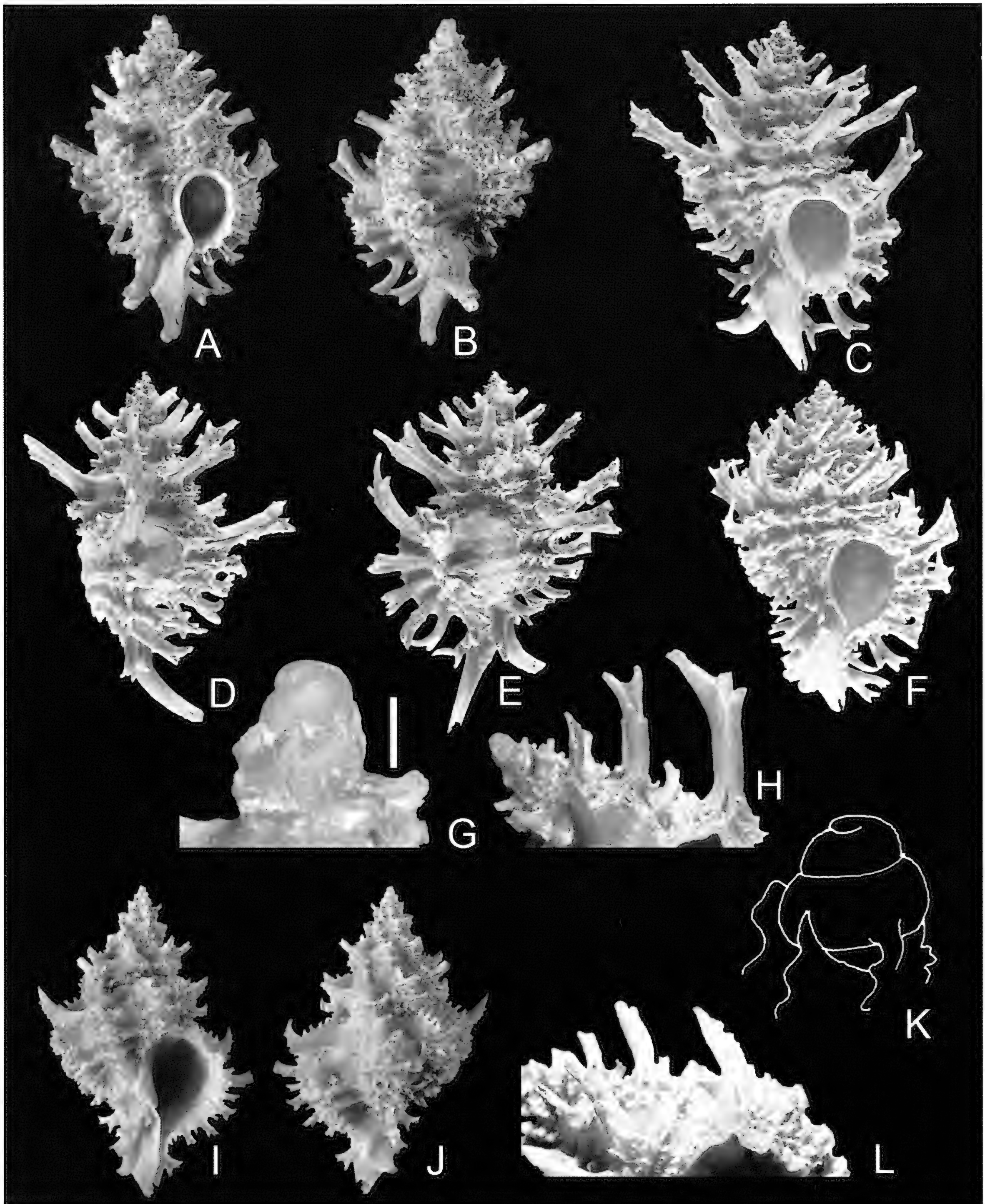
<sup>1</sup> *Attiliosa*, *Homalocantha*, *Pterynotus*, *Pterymarchia* and *Vitularia* did not show clear relationships with any of the subfamilial clades in Barco *et al.* (2010). They are assigned here to their subfamily following Molluscabase (2019) awaiting additional analysis.





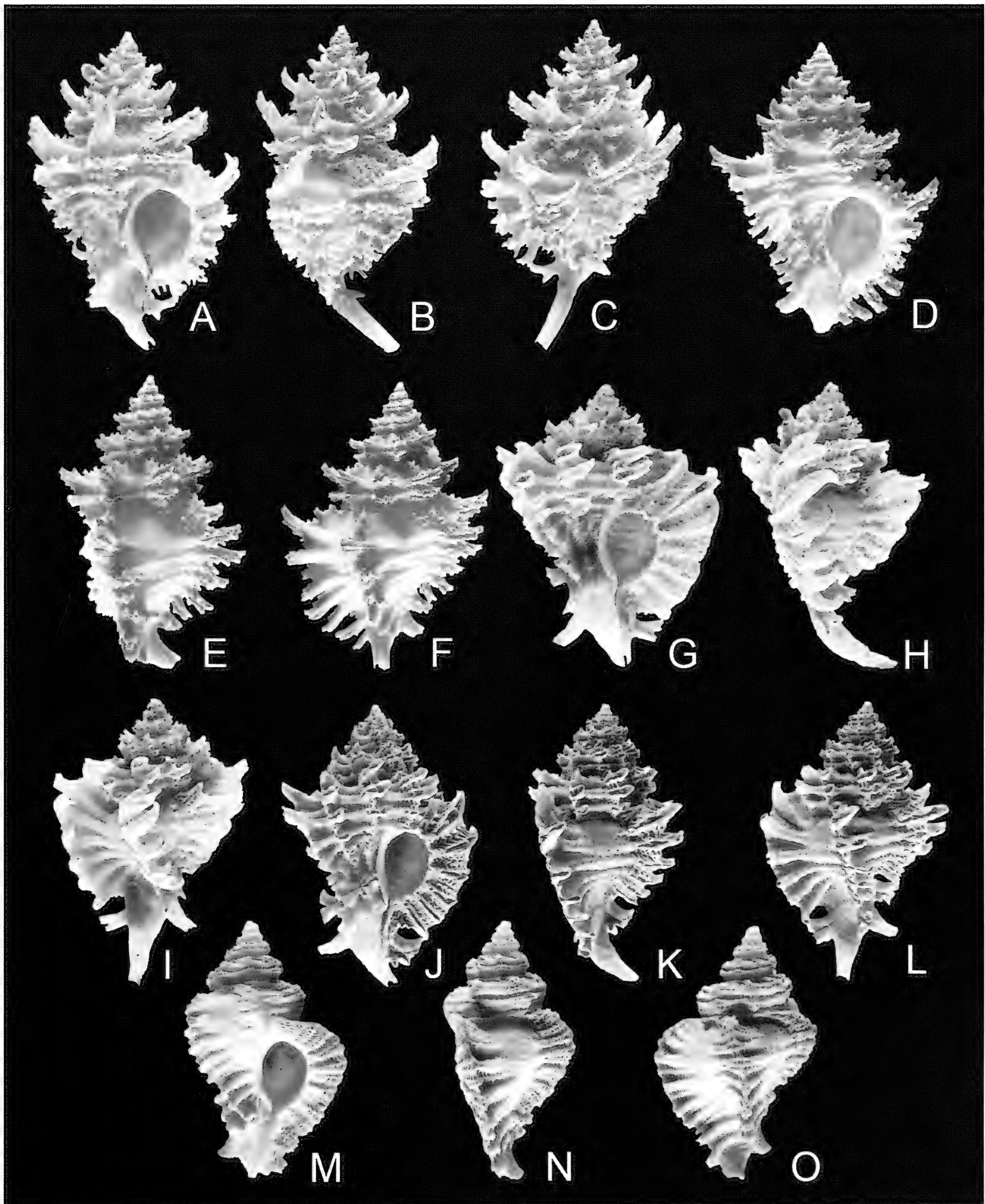
**Figure 3.** A–M. *Favartia madangensis* n. sp. A–E = Holotype IRSNB I.G.26086/MT.3863, 20.7 mm; F–H = Paratype IRSNB I.G.26086/MT.3864, 14.9 mm; I–L = Paratype IRSNB I.G.26086/MT.3867, 17.1 mm.





**Figure 4.** (scale bar 500  $\mu$ m) **A–H.** *Favartia pelepili* D'Attilio & Bertsch, 1980. **A–B** = Philippines, Bohol Straits, approximately 10°20' N, 124° E, holotype SDNHM T.S. 519, 33 mm (photo SDNHM); **C–D, H** = Philippines, Cebu, RH, 33.9 mm; **G** = Protoconch, Philippines, Cebu, RH. **I–L.** *Favartia judithae* D'Attilio & Bertsch, 1980. **I–J** = Philippines, Bohol Straits, between Cebu and Bohol Islands, approximately 10°20' N, 124° E, holotype SDNHM T.S. 521, 25 mm (photo SDNHM); **K** = Protoconch (reproduced from Myers & D'Attilio, 1986); **L** = Philippines, Mindanao, RH.





**Figure 5.** (scale bar 500  $\mu$ m) A–C = *Favartia judithae* D'Attilio & Bertsch, 1980, Philippines, Bohol Island, RH, 24 mm; D–F = *Favartia balteata* (Sowerby II, 1841), Philippines, Balut Island, RH, 20.6 mm; G–I = *Favartia cirrosa* (Hinds, 1844), Philippines, Bohol Straits, Mactan Island, RH, 18.2 mm; J–L = *Favartia voorwindei* Ponder, 1972, New Caledonia, Thios, RH, 15.8 mm; M–O = *Favartia morisakii* Kuroda & Habe, 1961, Japan, Shizuoka, RH, 13.8 mm.



## A new *Siphocypraea* species from the Immokalee Reef Tract (Unit 2) of the Tamiami Formation, Florida

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**ABSTRACT** A new species of *Siphocypraea* is described from the Immokalee Reef Tract (Unit 2), Tamiami Formation that represents an evolutionary link between *Siphocypraea (Lokossea) dimasi* Petuch, 1998 and *S. (L.) mulepenensis* Petuch, 1991.

**KEYWORDS** Cypraeidae, fossil cowries, Tamiami Formation, Fordville Member, Caloosahatchee Formation, Immokalee Reef Tract, *Siphocypraea*, *Siphocypraea (Lokossea)*, *Siphocypraea (Lokossea) daughenbaughi*, *Siphocypraea (Lokossea)*, *Siphocypraea (Lokossea) mulepenensis*, *Siphocypraea (Lokossea) dimasi*

### INTRODUCTION

The genus *Siphocypraea* Heilprin, 1886 was the first group of Plio-Pleistocene fossil cowries discovered in southern Florida and encompasses a group of related Cypraeidae species characterized by a curled apical sulci and narrow apertures (Heilprin, 1886; Petuch, Berschauer & Myers, 2018). The species were extant from the Buckingham Member (Unit 10) of the Tamiami Formation, circa 4.2 million years ago (“mya”), to the Ayers Landing Member of the Caloosahatchee Formation, circa 2 mya. In addition, the genus *Siphocypraea* (*sensu stricto*) has been further divided into three other subgenera, representing evolutionary lineages of species bearing similar features. The four subgenera are:

***Siphocypraea (Seminolecypraea)* Petuch and Drolshagen, 2011.** This subgenus represents the primitive stem stock of *Siphocypraea* from which all other subgenera evolved.

***Siphocypraea (Siphocypraea)* Heilprin, 1886 (*sensu stricto*).** This is the nominate subgenus and evolved from the deeper

lagoonal subgenus *Seminolecypraea* in Unit 3 of the Fruitville Member of the Tamiami Formation.

***Siphocypraea (Floridacypraea)* Petuch and Drolshagen, 2011.** This subgenus has a slightly coiled apical sulcus, an elongate, narrow shell and aperture. Confined to the Gelasian Pleistocene Caloosahatchee Formation.

***Siphocypraea (Lokossea)* Petuch and Drolshagen, 2011.** This subgenus has a tightly coiled multi-whorl apical sulcus, is large, inflated and rotund. Ranges from the late Piacenzian Pliocene to the late Gelasian Pleistocene. See below for the revised description of *Lokossea*. Previously named *S. (Lokossea)* species include: *S. (L.) dimasi* Petuch, 1998 (herein moved from the nominate subgenus), *S. (L.) mulepenensis* Petuch, 1991, *S. (L.) swearingeni* Petuch and Drolshagen, 2011, *S. (L.) wigginsii* Petuch and Drolshagen, 2011, and *S. (L.) registeri* Petuch and Drolshagen, 2011 (E.J. Petuch, personal communication; Petuch, Berschauer & Myers, 2018).



With the exception of *Siphocypraea* (*Lokossea*), the lineages of the other subgenera are complete. *Siphocypraea dimasi* was originally described in the genus *Siphocypraea* (*sensu stricto*) and based upon further study of its morphology it has been moved to the subgenus *Lokossea* (E.J. Petuch, personal communication; Petuch, 1998; Petuch and Drolshagen, 2011; Petuch, Berschauer & Myers, 2018). There is a gap in the fossil record between *Siphocypraea*

(*Lokossea*) *dimasi* Petuch, 1998 and *Siphocypraea* (*Lokossea*) *mulepenensis* Petuch, 1991, and as shown herein the new proposed Goldengate species *Siphocypraea* (*Lokossea*) *daughenbaughi* fills that gap (E.J. Petuch, personal communication). With the addition of this new species the *S. Lokossea* lineage (youngest to oldest) is as follows:

Species	Stratigraphic layer	Figure(s)
<i>S. (L.) registeri</i>	Ayers Landing, Caloosahatchee Formation	(Figure 2 K-L)
<i>S. (L.) wigginsii</i>	Bee Branch, Caloosahatchee Formation	(Figure 2 I-J)
<i>S. (L.) swearingeni</i>	Fort Denaud, Caloosahatchee Formation	(Figure 2 G-H)
<i>S. (L.) mulepenensis</i>	Unit 2 equivalent, Tamiami Formation	(Figure 2 E-F)
<i>S. (L.) daughenbaughi</i>	Unit 3 equivalent, Tamiami Formation	(Figures 1 A-F/2 C-D)
<i>S. (L.) dimasi</i>	Unit 4 equivalent, Tamiami Formation	(Figure 2 A-B)

SYSTEMATICS

Class: Gastropoda  
Subclass: Orthogastropoda  
Order: Sorbeoconcha  
Suborder: Hypsogastropoda  
Superfamily: Cypraeoidea  
Family: Cypraeidae  
Subfamily: Cypraeinae  
Genus: *Siphocypraea* Heilprin, 1886 (*sensu stricto*)  
Subgenus: *Lokossea* Petuch & Drolshagen, 2011

*Siphocypraea* (*Lokossea*) *daughenbaughi*  
Berschauer and Waller 2020  
(Figures 1A-F, 2 C-D)

**Description.** Shell of average size for the genus and subgenus, heavy, callous, inflated, oval/elongate with a slightly flattened to flattened base, anterior extremity slightly calloused and blunt, posterior extremity blunt, auricles small, apical sulcus tightly coiled, uncovered, aperture narrow throughout, curved to the left posteriorly, columella with 20-22

long, thin teeth extending well into the aperture, lip with 22-24 thin labral teeth extending into the coil of the apical sulcus and onto the base, fossula absent.

**Type Material.** HOLOTYPE - Figures 1A-C measuring 69.8 mm in length, LACMIP No. 42927.1 (type 14868). OTHER MATERIAL EXAMINED - two specimens measuring 63.2 (Figures 1D-F) and 61.0 mm in length in the study collection of John D. Daughenbaugh and one specimen measuring 62.0 mm in the study collection of Dr. Edward Petuch. Photographs of nine specimens (with measurements ranging up to 69.7 mm in length) from the collection of Melanie Briskin, Cape Coral, Florida, and two specimens from the collection of Maurice Guy (with measurements ranging from 59.0 to 69.0 mm in length) were also examined.

**Type Locality.** Bonita Grande Aggregate Pit, Bonita Springs, Lee County, Florida; LACMIP locality 42927.



**Stratigraphic Range.** Restricted to the upper beds of the Golden Gate Member, the equivalent of Unit 3, Fruitville Member, Tamiami Formation at Sarasota (Petuch & Roberts, 2017, p. 73). All known specimens have come from the Bonita Grande Aggregates Pit, Bonita Springs, Lee County, Florida.

**Etymology.** Named for John D. “Duffy” Daughenbaugh, Los Angeles, California, an avid collector and researcher of recent and fossil Cypraeidae and author of a series of articles on the fossil Cypraeidae of the Tamiami and Caloosahatchee Formations by stratigraphic unit.

**Discussion.** The subgenus *Lokossea* as modified is represented by variably shaped species that are slightly inflated/inflated with tightly coiled apical sulci, long thin columellar dentition that extends deep into the aperture and labral dentition that extends well onto/over the base, forming corrugations (Petuch and Drolshagen, 2011; Daughenbaugh, 2020).

As the successor of *S. (L.) dimasi*, the oldest member of the subgenus, *S. (L.) daughenbaughi* retains the flattened base, tightly coiled apical sulcus, reduced number of long thin columellar teeth that extend well into the aperture as well as corrugated labral dentition. Despite its diminutive size, which has obscured its presence and position in the subgenus, *S. (L.) dimasi* presaged these main features which are present in all of the *Lokossea* species. The principle differences between the two species is a covered apical sulcus in *S. (L.) dimasi* and a more open sulcus in *S. (L.) daughenbaughi*, the number of columellar and labral teeth, and *S. (L.) daughenbaughi* has a much larger shell and is higher domed and more inflated than *S. (L.) dimasi*. The degree to which the apical sulcus is covered or open varies among the species of the subgenus.

*Siphocypraea (Lokossea) daughenbaughi* is closest to its successor *S. (L.) mulepenensis* but differs in its less inflated oval/elongate shape versus high domed and globular shape, slightly flattened/flattened base versus rounded base, more open apical sulcus versus partially covered apical sulcus, lesser columella teeth (20-22 versus 25-27), lesser labral teeth (22-24 versus 30-32) and labral teeth that extend onto and over the base. The new species *S. (L.) daughenbaughi* is relatively uncommon in the Bonita Springs Aggregate Pit (Melanie Briskin, personal communication), but has previously been incorrectly assigned to other species. Specimens of *S. (L.) daughenbaughi* exhibit a significant amount of variability in width, height, and the degree to which the apical sulcus is open. It is unknown whether this variability is environmental, temporal or a result of genetic plasticity.

The assignment of *S. (L.) daughenbaughi* to Unit 3 of the Immokalee reef tract is provisional. The Immokalee Reef Tract (Unit 3) facies intertongue with the Fordville facies. As these sediments are close to the surface, the mining of these sediments tends to intermingle the two strata, which makes it impossible to definitively assign a specific Unit. However, based upon morphological features, it is placed in Unit 3 time (an estimated 2.8 million years ago) as the successor to *S. (L.) dimasi* and predecessor to *S. (L.) mulepenensis*, the later provisionally assigned to the Unit 2 equivalent, Tamiami Formation. (See Daughenbaugh, 2020) The best preserved specimens were found in muddy clay and sand between 2013-2020 (personal communications Briskin and Guy).



Characteristic	<i>S. (L.) mulepenensis</i>	<i>S. (L.) daughenbaughi</i>
Shape	Domed, globular	Less inflated, oval, elongate
Base	Rounded	Slightly flattened/flattened
Sulcus	Partially covered	More open/uncovered
Columellar Teeth	25-27	20-22
Labial Teeth	30-32	22-24 extending onto base

Table 1. Comparison of *S. (L.) mulepenensis* and *S. (L.) daughenbaughi*.

The specimen shown in Figure 1 D-F was particularly well preserved and retained some of the spotting on its dorsal margins. The use of ultraviolet light in the study of fossil shells is a well recognized technique. (Krueger, 1974; Hendricks, 2018) Accordingly, the right side of the two specimens shown in 1A-C and 1D-F were photographed both in natural daylight and ultraviolet light in order to identify any pattern that may have existed in the living species, and are illustrated here in Figure 3. Marginal spotting is clearly visible in these images.

ACKNOWLEDGMENTS

Special thanks to Melanie Briskin, Louise J. Briskin, and Maurice Guy, who each have conducted a lifetime of field work in the fossil quarries in southern Florida, for personal communications regarding this subject and this new species in particular. The authors thank John D. Daughenbaugh for the loan of the type specimens for study and for the donation of the holotype. Further, the authors thank Dr. Edward J. Petuch for his invaluable friendship, mentoring, and assistance in the preparation of this article.

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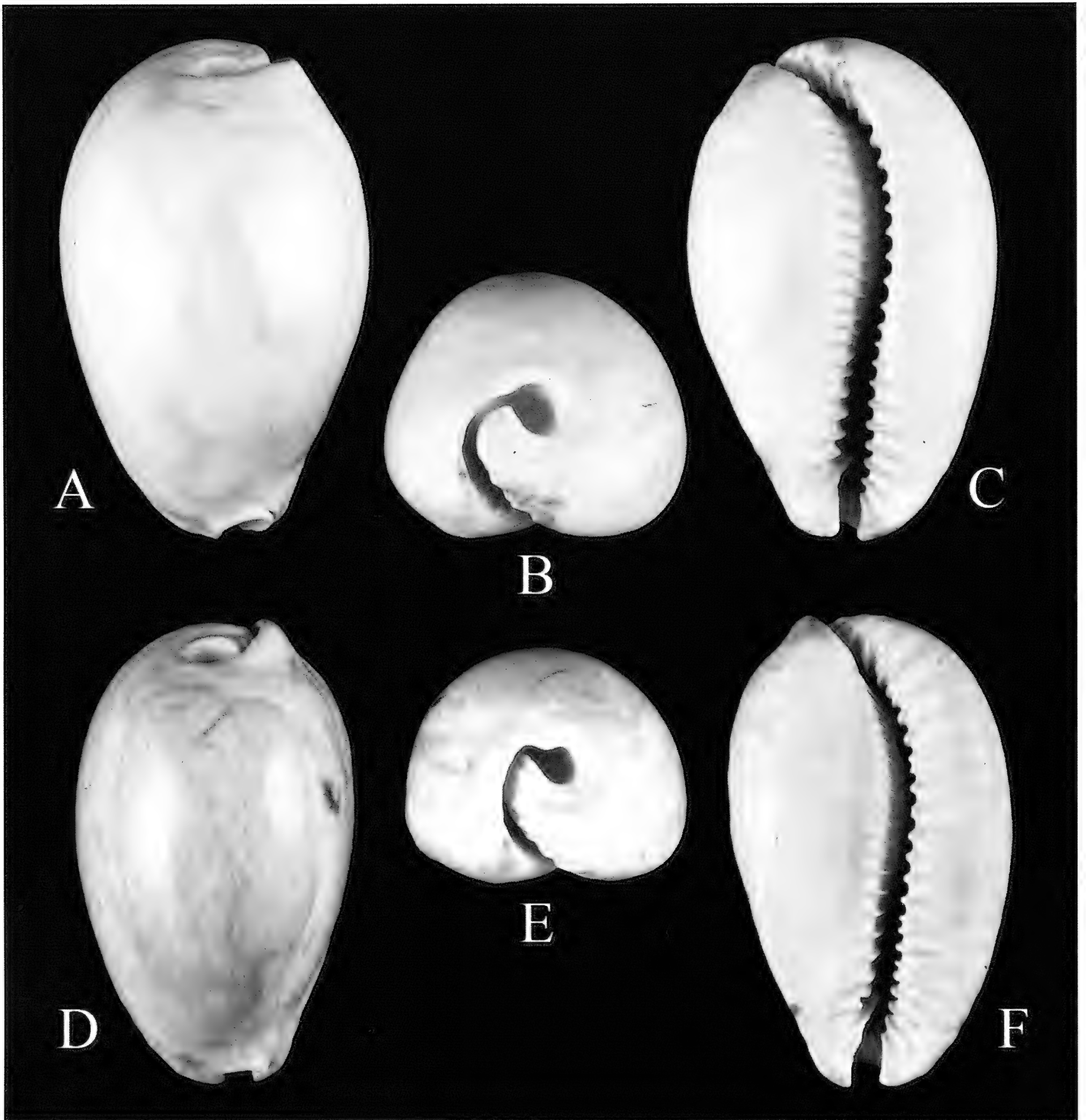
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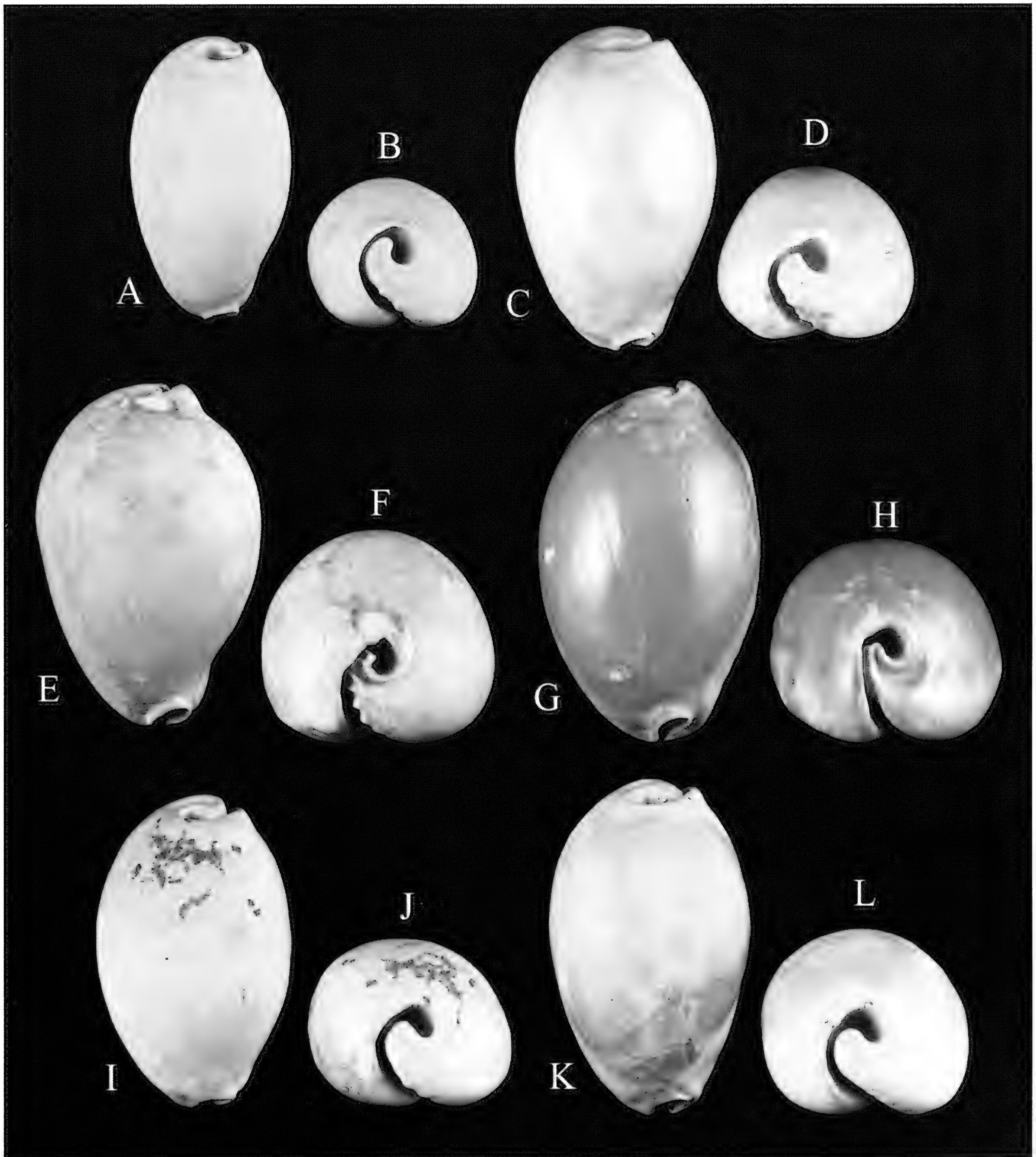
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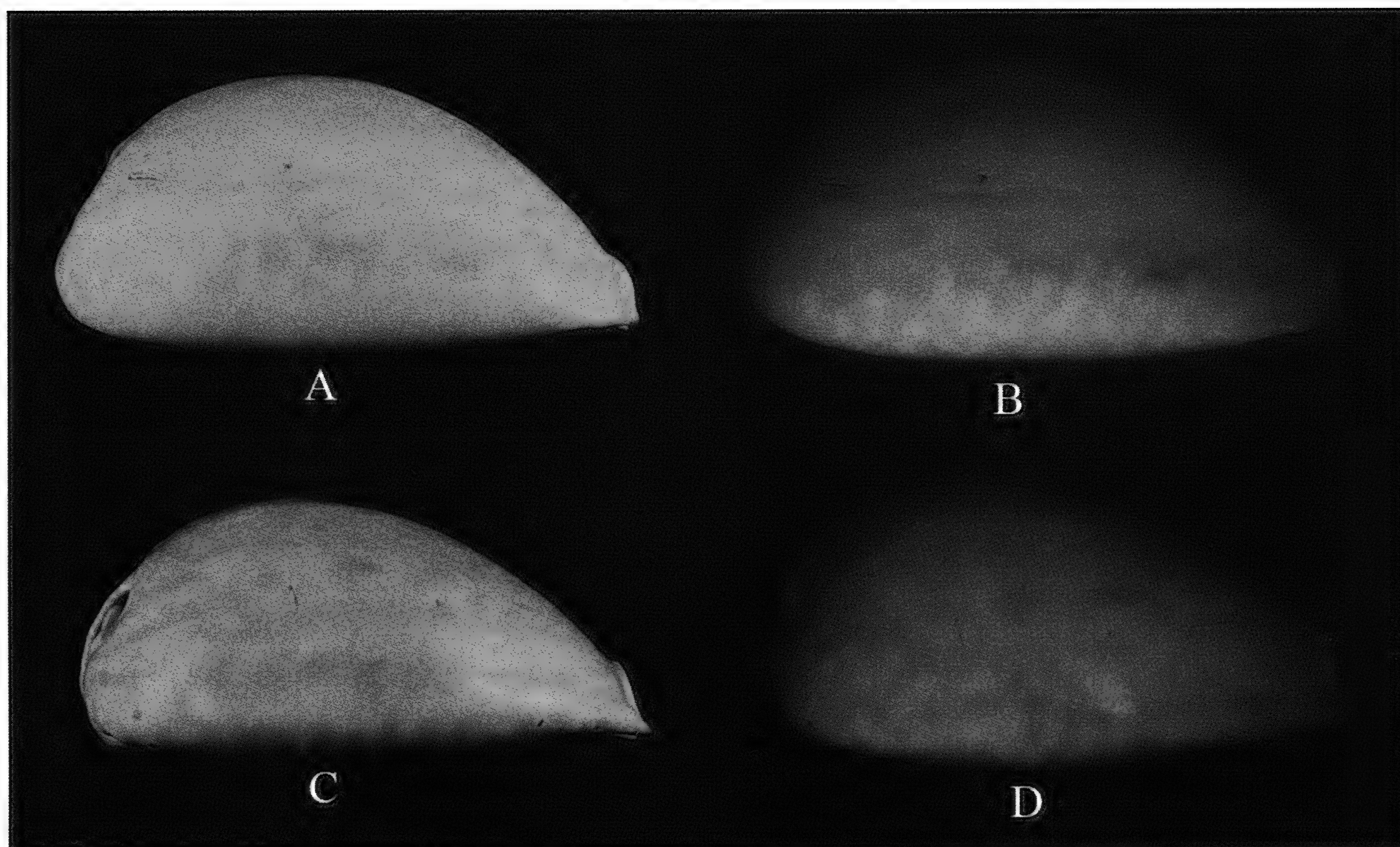
**Figure 1. New species of *Lokossea*.** A, B, C = *Siphocypraea (Lokossea) daughenbaughi* Berschauer and Waller, new species, holotype, 65.6 mm in length, LACMIP 42927.1 (type 14868); D, E, F = *Siphocypraea (Lokossea) daughenbaughi* Berschauer and Waller, new species, 62.3 mm in length (Daughenbaugh Collection).





**Figure 2. Comparison of *Lokossea* species.** A, B = *Siphocypraea (Lokossea) dimasi* Petuch, 1998, 50.1 mm in length, Florida Rock Industries, Old Mule pen Quarry, Naples, Collier County. C, D = *Siphocypraea (Lokossea) daughenbaughi* Berschauer and Waller, new species, holotype, 65.6 mm in length, Bonita Grande Aggregates Pit, Bonita Springs, Lee County; LACMIP 42927.1 (type 14868). E, F = *Siphocypraea (Lokossea) mulepenensis* Petuch, 1991, 71.3 mm in length, Florida Rock Industries, Old Mule pen Quarry, Naples, Collier County. G, H = *Siphocypraea (Lokossea) swearingeni* Petuch and Drolshagen, 2011, 74.4 mm in length, Griffin Brothers Pit, Hole Land Wildlife Conservation Area, Palm Beach Co. I, J = *Siphocypraea (Lokossea) wigginsii* Petuch and Drolshagen, 2011, 61.2 mm in length, Star Ranch Pit, Palm Beach County. K, L = *Siphocypraea (Lokossea) registeri* Petuch and Drolshagen, 2011, 65.4 mm in length, Bergeron Star Pit Mine, Palm Beach County.





**Figure 3.** Ultraviolet light images of *Siphocypraea* (*Lokossea*) *daughenbaughi* Berschauer and Waller, new species. **A, B** = holotype, 65.6 mm in length, LACMIP 42927.1 (type 14868); **C, D** = 62.3 mm in length (Daughenbaugh Collection).



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## The Fossil Cypraeidae of the Fruitville Member (Unit 2) and Kissimmee River Valley Equivalent, Tamiami Formation of Southern Florida: (Mollusca: Gastropoda: Cypraeidae)

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**ABSTRACT** Unit 2 was the last member of the Tamiami Formation of the Late Piacenzian Pliocene. Its ending signaled the commencement of a two stage extinction event. The first stage wounding event resulted in the disappearance of the *Akleistostoma* (Gardner, 1948), *Calusacypraea* (Petuch, 1996) and *Pseudadusta* (Petuch, 2004) genera and the end of the Tamiami Formation.

**KEYWORDS** Tamiami Formation, Fruitville Member (Unit 2), Unit 2 equivalent, *Akleistostoma*, *Siphocypraea*, *Pahayokea*, *Calusacypraea*, *Okeechobea*, *Pseudadusta*, Myakka Lagoon System (Myakka), Kissimmee Embayment, Kissimmee River Valley (Kissimmee), Caloosahatchee Strait, Loxahatchee Strait, Okeechobee Plains, Immokalee Reef Tract, Everglades Pseudoatoll.

### INTRODUCTION

The transition from Unit 3 to Unit 2 time was marked by a continuation of falling sea levels, to levels below Unit 3 time, as temperatures again fell. Lower sea levels and temperatures resulted in altered molluscan habitats producing new species in a sequential evolutionary radiation as the populations adapted to these habitats. The ten Fruitville Member (Unit 3) Cypraeidae species in four genera of the Myakka Lagoon System were followed by a like number of new species in the same four genera, which evolved in Fruitville (Unit 2) time. In the Kissimmee River Valley, the four Unit 3 equivalent species in two genera were followed by seven new species in three genera, which emerged in that area. In the Immokalee Reef Tract (Unit 2), one new species has been recorded and described. While *Okeechobea* (Petuch, 2004) Unit 3 equivalent species have not been recorded from Kissimmee, two species of the genera have been recorded from Unit 2 equivalent strata.

Unit 2 marks the end of the Tamiami Formation and the last Cypraeidae radiation of the late Piacenzian Pliocene. For the Cypraeidae genera this meant either adaptation or extinction.

### Fruitville (Unit 2) Myakka Lagoon System

In the western Myakka estuary, Fruitville Unit 2, present day Sarasota region, the mangrove forests were reduced to the extent that they were no longer a viable habitat for molluscan populations. The iconic Unit 3 pearly mussel *Perna conradiana* (d’Orbigny, 1852) beds that formed in the large quartz sand intertidal shoals were overlain by beds of *Chama gardnerae* Olsson and Harbison, 1953 (cemented saltwater clams). As with the *P. conradiana* beds, patches of sea grass were scattered between the *Chama* beds and hosted many of the Unit 2 Cypraeidae. The mud flats remained a viable Cypraeidae habitat and adjoined the sea grass patches.

The sea grass patches were associated with *Siphocypraea* (*Seminolecypraea*) *alligator* Petuch, 1994 (Figure 1F) and *Calusacypraea*



(*Myakkacypraea*) *schnireli* Petuch, 2004 (Figure 1G) as their preferred habitat. They also hosted *Pseudadusta marilynae* (Petuch, 1994) (Figure 1H).

Myakka Cypraeidae populations remained isolated in Unit 2 time. The neotenic Cypraeid genus *Calusacypraea* (Petuch, 1996) remained isolated in Myakka throughout Pinecrest and Fruitville times.

### **Fruitville (Unit 2) Kissimmee River Valley Equivalent**

In the east, as in Myakka, the receding sea levels resulted in widespread intertidal shoals forming with the greatest concentration along the western side of the embayment. Dense, thick beds of the scallop *Carolinapecten bertiensis* (Mansfield, 1946) formed along the deeper open sand patches adjacent to the east of the shoals. Sea grass beds were interspersed with the scallop beds and these formed the preferred habitat for the Unit 2 equivalent Cypraeidae, which have been collected along the same strata as the *Carolinapecten*, e.g. at Rucks Pit, and further south along the Kissimmee River Valley.

During Unit 2 equivalent time, a series of narrow cuts across the St. Lucie Peninsula connected the northern end of the embayment with the Atlantic Ocean. These cuts formed cooler water corridors for the invasion of contemporaneous Virginia and Carolinas Chowan River Formation (Edenhouse Member) molluscan fauna into the embayment, including *Carolinapecten bertiensis*. The invasive fauna settled at the northern end of the embayment and were unable to move further south. While marine conditions were cooler, they were still able to support the last remaining Cypraeidae populations.

### **Immokalee Reef Tract (Unit 2)**

The degradation of the coral reefs in the Immokalee Reef Tract, specifically those in Lee and Collier Counties, began in Unit 2 time and continued into the succeeding Fordville Member, Caloosahatchee Formation. The degradation process resulted in the depositional environment staying constant throughout. As a result, Unit 2 and Fordville Immokalee Reef Tract sediments in the present day appear the same. This was the result of the intertonguing of these two laterally adjacent (next to each other) strata facies. In other words, the carbonate facies of the Fordville-aged reefs intertongue with the subjacent carbonate facies of the upper Immokalee Reef Tract (Unit 2) of the Golden Gate Member. As these sediments are close to the surface, their mining tends to intermingle the two strata. As a result, the present placement of the of the Cypraeidae species into either Unit 2 or the Fordville Member reef sediments should be considered provisional.

### **Unit 2 Ends, First Stage Wounding Event**

The end of Unit 2 signaled the commencement of a two stage sequential extinction event (Petuch, 1995, pp. 275-277). The first stage was a wounding event caused by the abrupt cooling of sea waters and the accompanying drop of water levels. Cooling temperatures and lower sea levels reached their nadir at the end of Unit 2 time, c. 2.65 mya. This event was characterized by the degradation of the extensive coral reef tracts that outlined the Everglades Pseudoatoll as well as the reduction of a great number of sea grass beds, mud flats and mangrove forests. By the end of Unit 2 time, the marine environments of southern Florida had become landlocked with the center of the Everglades Pseudoatoll becoming a landlocked salt water lake surrounded by degrading reef tracts.



## Extinction

At this time, the *Akleistostoma* (Gardner, 1948), *Calusacypraea* (Petuch, 1996) and *Pseudadusta* (Petuch, 2004) genera became extinct while three Cypraeidae genera, *Siphocypraea* Heilprin, 1886, the related *Pahayokea* (Petuch, 2004) and *Okeechobea* Petuch, 2004 survived this wounding event in the estuarine environments of southern Florida. These Cypraeidae populations, especially *Siphocypraea*, did survive, rebound and radiate in southern Florida during the early Gelasian Pleistocene, a period of modest warming. However, ecological habitats and populations were not fully restored before a second extinction occurred. Coupled with the wounding event, this second extinction event resulted in the mass extinction of all remaining Cypraeidae populations. This occurred at the end of the Gelasian Age, Early Pleistocene, c. 1.8 mya, with the return of cooling waters and dropping sea levels. (Petuch, 1995 and 2004).

## Fruitville Member Species – Unit 2

### Myakka Lagoon System (Sarasota)

*Akleistostoma adrianae* Petuch and Drolshagen, 2011 (Figure 1A)

*Akleistostoma (Mansfieldicypraea) ivyi* Petuch and Drolshagen, 2011 (Figure 1B)

*Siphocypraea janowskyi* Petuch and Drolshagen, 2011 (Figure 1C)

*Siphocypraea (Seminolecypraea) alligator* Petuch, 1994 (Figure 1E)

*Calusacypraea loxa* Petuch and Drolshagen, 2011 (Figure 1G)

*Calusacypraea (Myakkacypraea) schnireli* Petuch, 2004 (Figure 1D)

*Pseudadusta marilynae* (Petuch, 1994) (Figure 1H)

*Pseudadusta yingsti* Petuch and Drolshagen, 2011 (Figure 1F)

*Pseudadusta (Bithloa) juyingae* Petuch and Drolshagen, 2011 (Figure 1I)

*Pseudadusta (Bithloa) gumbinneri* Petuch and Drolshagen, 2011 (Figure 1J)

### Kissimmee Embayment (Kissimmee River Valley restricted) Unit 2 equivalent

*Akleistostoma (Ingramicypraea) ingrami* (Petuch and Drolshagen, 2011) (Fig. 2A) ++

*Akleistostoma (Ingramicypraea) glennae* Petuch and Drolshagen, 2011 (Figure 2B)

*Akleistostoma (Olssonicypraea) zahinai* Petuch and Drolshagen, 2011 (Figure 2G)

*Pahayokea mauriceguyi* Petuch, Berschauer and Myers, 2018 (Figure 2C)

*Pahayokea (Kissimmecypraea) lybrandi* Petuch and Drolshagen, 2011 (Figure 2D)

*Okeechobea fortdrumensis* Petuch and Drolshagen, 2011 (Figure 2E)

*Okeechobea (Yeehawcypraea) lindajoyceae* Petuch and Drolshagen, 2011 (Figure 2F)

### Immokalee Reef Tract (Unit 2)

*Siphocypraea (Lokossea) daughenbaughi* Berschauer and Waller, 2020 (Figure 2H) \*

Altogether, 18 species in seven genera have been collected in Unit 2 deposits.

\* **NOTE:** The assignment of this species to Unit 2 time and the reclassification and reassignment of *Siphocypraea (Lokossea) dimasi* Petuch, 1998 to Unit 3 time is provisional.

*Siphocypraea dimasi* is reclassified and reassigned from its present uncertain placement in either Unit 2 or the Fordville Member into Unit 3 as the first and oldest species of the *Siphocypraea (Lokossea)* Petuch and Drolshagen, 2011 subgenus. The subgenus features include “large, inflated, rotund species with very tightly coiled apical sulci”. However, with the addition of these two species, the subgenus is revised to include variably shaped species which are slightly inflated/inflated with tightly coiled apical sulci, long thin columellar dentition, which extends deep into the aperture and labral dentition, which extends well



onto/over the base, forming corrugations. The latter are obvious on some species while eroded on others or hidden by callus. The corrugations in most specimens are visible under black light.

When first described, *S. dimasi* was only known from the back reef lagoon environment, adjacent to the corals of the Immokalee reefs at the old Mule Pen Quarry at Naples, Florida. It was placed in Unit 3 based upon its similarity to *Siphocypraea cannoni* Petuch, 1994 from the Sarasota quarries. Subsequent collecting produced a few specimens from the Sarasota quarries, suggesting it is exceedingly rare. While *S. dimasi* was similar to *S. cannoni*, its size, more slender shape and more coiled apical sulcus separated these two species. The species shared strong labral corrugations; a feature also shared with *S. (L.) daughenbaughi* and all other species of the subgenera. Based on morphological features, the species is returned to its initial Unit 3 assignment.

The assignment of *S. (L.) daughenbaughi* to Unit 2 of the Immokalee reef tract is also provisional. As set forth above, the reef tract facies intertongue, which along with the mining of the facies, makes it impossible to definitively assign a specific Unit time. However, based upon morphological features, it is placed in Unit 2 time as the successor to *S. dimasi* and predecessor to *Siphocypraea (Lokossea) mulepenensis* Petuch, 1991, the latter provisionally assigned to the Fordville Member. (See Berschauer and Waller, 2020).

#### **++ Reclassification**

Based on a resemblance to the older, Unit 3 *Akleistostoma rilkoi* (Petuch, 1998) of the Myakka Lagoon System, *Akleistostoma ingrami* was originally classified as the only Kissimmee *Akleistostoma* species in the *Akleistostoma* genus. However, the species actually bears a

closer resemblance to certain specimens of the Unit 4 subgenus species *Akleistostoma (Ingramicypraea) cliffordi* Petuch and Drolshagen, 2011. The only difference appears in the shape of the specimens. As set forth previously (Daughenbaugh, Unit 4 and 3, 2019, 2020), Kissimmee was separated from Myakka by the massive Polk Peninsula and lacked any viable means of transport between the two areas. Based on the separation as well as the likely presence of an ancestor in the Kissimmee, the species is reclassified as *Akleistostoma (Ingramicypraea) ingrami* (Petuch and Drolshagen, 2011).

#### **Origins**

At Sarasota, both *A. adrianae* and *A. (M.) ivyi* appear to be offshoots of *Akleistostoma (Mansfieldicypraea) juliagardnerae* Petuch and Drolshagen, 2011. *Siphocypraea janowskyi* is probably descended from *Siphocypraea cannoni* Petuch, 1994 while *S. (S.) alligator*, the last species of the subgenus, resembles a more rostrate *Siphocypraea (Seminolecypraea) parodizi* Petuch, 1994. Occurring together at Sarasota, *C. loxa* and *C. (M.) schnireli* are the last species of the genus and subgenus. They resemble their immediate ancestors. The former resembles *Calusacypraea sarasotaensis* (Petuch, 1994) but is a more elongate shell with a much narrower aperture. The latter resembles a more truncated version of *Calusacypraea (Myakkacypraea) kelleyi* (Petuch, 1998). Both *P. marilynae* and *P. yingsti* appear to be offshoots of *Pseudadusta ketteri* (Petuch, 1994) while both *P. (B.) juyingae* and *P. (B.) gumbinneri* appear to be offshoots of *Pseudadusta (Bithloa) kalafuti* (Petuch, 1994).

At Kissimmee, the ancestor of *A. ingrami* is uncertain (see above). There are two variations of *A. (O.) glennae*. Both resemble *Akleistostoma (Olssonicypraea) diegelae* (Petuch, 1994), the



smaller resembles a more callous variation and the larger a more callous and deltoidal variation. *Akleistostoma* (*Olssonicypraea*) *zahinai* resembles its immediate ancestor, *A. (O.) diegelae*. The Unit 3 equivalent *Pahayokea penningtonorum* (Petuch, 1994) precedes the younger *P. mauriceguyi*, a more cylindrical, blunter shell. *Pahayokea (Kissimmecypraea) lybrandi* is a slenderer version of the large variation of *Pahayokea (Kissimmecypraea) leonardi* Petuch and Drolshagen, 2011 with finer columellar teeth. The ancestors of both *O. fortdrumensis* and *O. (Y.) lindajoyceae* are uncertain as no species of either the genus or subgenus have been recorded from Unit 3 equivalent.

In the Immokalee Reef Tract, *S. (L.) daughenbaughi* is the likely successor to *S. (L.) dimasi*. The latter has no known ancestor.

For detailed genera and species descriptions, background information and discussion, see *Jewels of the Everglades, The Fossil Cowries of Southern Florida*, 2018, by Edward J. Petuch, David P. Berschauer and Robert F. Myers.

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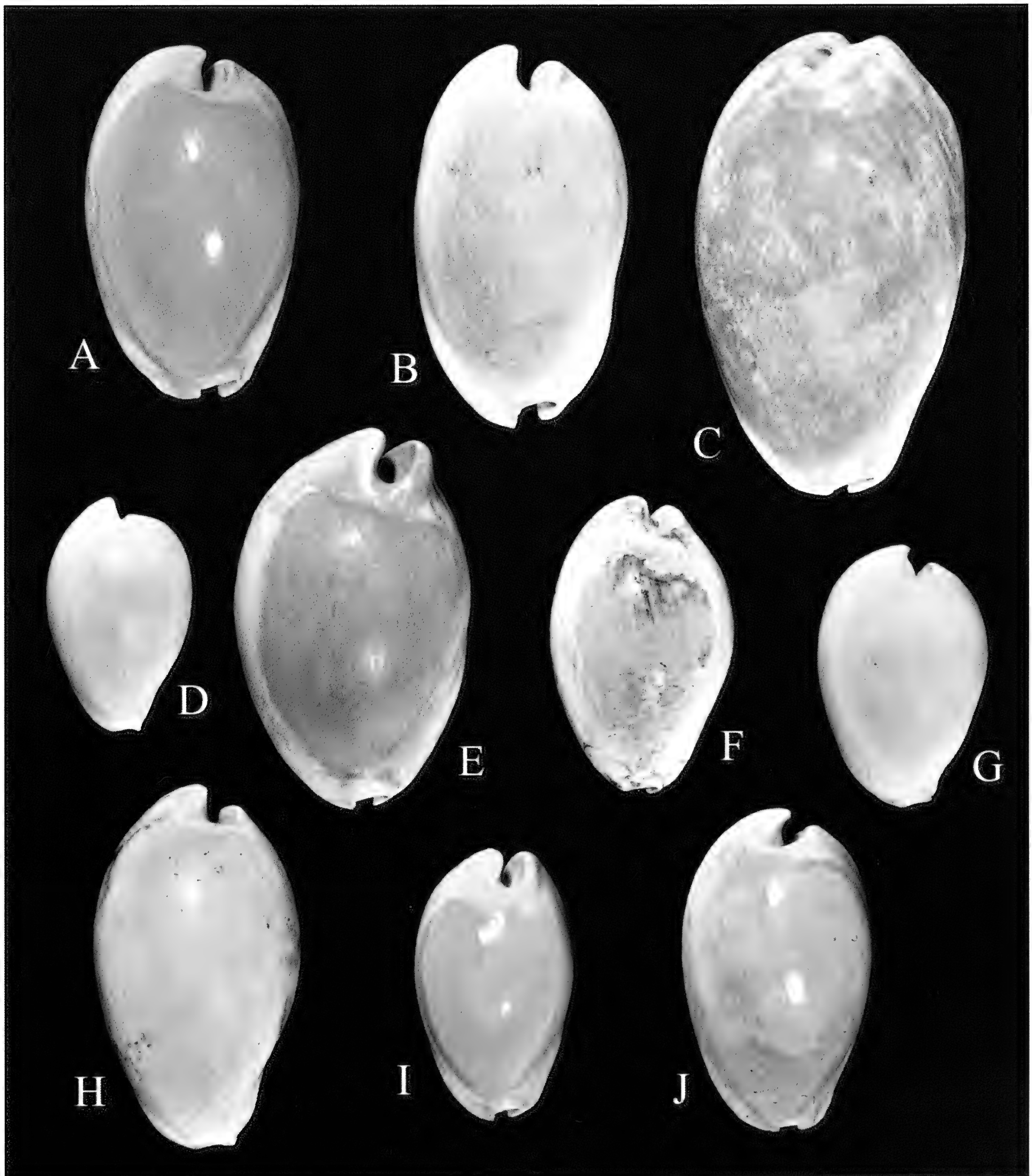
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**Figure 1. Myakka Lagoon System, Sarasota (Unit 2).** A = *Akleistostoma adrianae* Petuch and Drolshagen, 2011, length = 57.3 mm; B = *Akleistostoma (Mansfieldicypraea) ivyi* Petuch and Drolshagen, 2011, length = 61.9 mm; C = *Siphocypraea janowskyi* Petuch and Drolshagen, 2011, 74.7 mm; D = *Calusacypraea (Myakkacypraea) schnireli* (Petuch, 2004), length = 38.0 mm; E = *Siphocypraea (Seminolecypraea) alligator* (Petuch, 1994), length = 62.3 mm; F = *Pseudadusta yingsti* Petuch and Drolshagen, 2011, length = 48.1 mm; G = *Calusacypraea loxa* Petuch and Drolshagen, 2011, length = 42.2 mm; H = *Pseudadusta marilynae* (Petuch, 1994), length = 58.4 mm; I = *Pseudadusta (Bithloa) juyingae* Petuch and Drolshagen, 2011, length 45.0 mm; J = *Pseudadusta (Bithloa) gumbinneri* Petuch and Drolshagen, 2011, length = 50.0 mm.





**Figure 2. Kissimmee River Valley (Unit 2 equiv.) A-G, Bonita Springs H.** A = *Akleistostoma ingrami* Petuch and Drolshagen, 2011, length = 56.2 mm; B = *Akleistostoma (Ingramicypraea) glennae* (Petuch and Drolshagen, 2011), length = 46.5 mm; C = *Pahayokea mauriceguyi* Petuch, Berschauer and Meyers, 2018, length = 53.1 mm; D = *Pahayokea (Kissimmecypraea) lybrandi* Petuch and Drolshagen, length = 66.9 mm; E = *Okeechobea fortdrumensis* Petuch and Drolshagen, 2011, length = 57.0 mm; F = *Okeechobea (Yeehawcypraea) lindajoyceae* Petuch and Drolshagen, 2011, length = 36.4 mm; G = *Akleistostoma (Olssonicypraea) zahinai* Petuch and Drolshagen, 2011, length = 37.9 mm; H = *Siphocypraea (Lokossea) daughenbaughi* Berschauer and Waller, 2020, length = 63.2 mm.



**Description of four species of *Marginella*, Lamarck, 1799,  
from the Neogene beds of Algarve, Portugal and Port Elizabeth,  
South Africa, respectively**

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**ABSTRACT** The relative similarity between *Marginella*'s from the Neogene in Portugal and Italy, and South Africa, is investigated, and comparative living species are illustrated, with four new fossil species described and the redescription of *Marginella stephaniae*.

**KEYWORDS** *Marginella*, Cacela, Algarve, Tortonian, Alexandria Formation, *Marginella goncalvesi*, *Marginella stephaniae*, *Marginella zwartkopsensis*, *Marginella pseudopoppei*, *Marginella antepiperata*

## INTRODUCTION

Species of the Genus *Marginella* Lamarck, 1799, from the Neogene (Pliocene) beds of the Alexandria formation in the Port Elizabeth area, along with other gastropods, have been known for some time. A fortuitous meeting with Carlos Goncalves in Portugal resulted in the presentation of interesting material from the Neogene beds at Cacela, Algarve, and the subsequent hypothesis that their closest congener existed from/in the so-called Alexandria Formation in South Africa, from which specimens have been known and documented. In the South African Journal of Geology 93(3) 514-518 (1990), a pertinent piece of information is noted, as follows: "Newton (1913), on account of similarities of certain Alexandria fossils with those of European and South American species, assigned a Mio-Pliocene age to the Alexandria formation."

The author's comprehensive knowledge of the living marginellids, particularly in South Africa, led to the realization that by far the closest comparative species to these "northern " fossils

exists in South Africa, and not West Africa, as might be assumed. Comparative living species are illustrated to add impetus to this theory.

As with our modern species, it must be emphasized that even more so in the case of fossils, researchers tend to be limited to morphology, size, pattern, labial characteristics and possibly the columellar/parietal callus, as characters to determine species.

## WORKS AND INTERPRETATIONS OF RECENT AUTHORS

Various authors have contributed to our knowledge of the possible origins of this genus. Coover & Coover, 1995, suggest that the Genus *Marginella*, Lamarck, 1799, may initially be found in the fossil record of the Miocene & Pliocene of Italy, to recent times. da Silva, *et al.* 2011, speaking of the Iberian Atlantic Neogene, offer as follows: "Today, the greatest diversity of Marginellids, about 90% of the species according to Coover & Coover, are in West Africa and South Africa. Therefore, the genus may have originated in South Africa" ... "During the Miocene, one vast tropical



European - West African Province extended from France to Angola” (da Silva, *et al.* 2011.) Sosso, Brunetti and Dell ‘Angelo in their paper on the Marginellidae of the Piedmont area, Italy, state ... “The family Marginellidae apparently originated in the ancient Tethys Sea” (Sosso, Brunetti & Dell ‘Angelo, 2015).

T. Cossignani, in his comprehensive book on worldwide Marginellidae, fossil section, does not illustrate or mention seemingly important Portuguese material. da Silva, Landau & La Perna speculate that “*Marginella* may have originated in Southern Africa and migrated north to Europe in the Miocene, never extending further north than West Central Portugal.” In their paper, Biogeography of Iberian Atlantic Neogene marginelliform Gastropods, under discussion of *M. stephaniae*, they state “the peculiar shape of *Marginella stephaniae* makes it difficult to suggest any close affiliation to other Recent or Fossil marginellids.” (da Silva, *et al.* 2011.) Their mention of *Marginella goodali* (sic), as a potential comparative is interesting, but clearly different. Their illustrations in Figure 4 show instinctive separation between *M. stephaniae*, (Numbers 1 to 4), and the smaller, broader shell that is named herein as *Marginella goncalvesi*, new species (See, numbers 5 to 8).

Considering that this present paper represents a picture of a very narrow ‘time frame’ in geological history, it becomes possible to present a group of species that are, in conjecture, the first currently known members of this genus, which are at this stage assumed to have split from the Volutidae possibly in the Tethys Sea, at some point. It is pertinent to realize that the volutid genus *Athleta* has representation as fossils in the U.S.A, and Paris, France area, and living examples deep off the southern part of Africa.

F.A.D van Nieulande studied Marginellids from the Paris basin in 1981, mentioning some 19 species, which he places in the genus *Stazzania*. However, all these are small to very small in size, and from their illustrated sizes and morphology, have a much stronger affinity to that of the genus *Dentimargo*. La Perna and Vazzana, in their article “On the last occurrence of the Genus *Marginella* in the Mediterranean”, mention as follows: “The genus *Marginella* was thought to have disappeared from the Mediterranean and the adjacent Atlantic after the early Pliocene, due to early cooling phases.” They continue ... “High productivity seems to have been a key factor in the Mediterranean distribution of *Marginella*, either in shallow or deeper waters.” (La Perna & Vazzana, 2016)

In their very recent revision of the phylogeny of marginelliform gastropods, “Mapping the missing branch on the Neogastropod tree of life”, Fedosov *et al.* state that these gastropods in general “date back to at least the Eocene or late Cretaceous.” Limited attention in this paper is paid to the genus *Marginella* Lamarck, 1799, other than to consolidate the genus *Glabella* with *Marginella*. (Group MM3). No species from the extremely rich area of South Africa is mentioned or illustrated. (Fedosov *et al.* 2019.)

Based on the sheer number of species, and their known non-planktonic distribution, it is paleontologically fascinating that these alike fossils, found so relatively far apart, have some distinct ancient connection. As mentioned, it has been proposed that *Marginella*’s originated in South Africa, and may have ‘migrated upwards’, but no further ‘north’ than Italy and central Portugal, (Iberian Peninsula) over this time. This is in contrast to the many Volutidae fossil species from France, found even further north. Contrary thinking would be that the genus *Marginella* split from Volutidae in the Tethys sea, and moved southward during warm



times, from France, and established itself in the Mediterranean region.

Mention should be made of the Genus *Myobarum*, which appears in Coover & Coover, as it was described from the Late Cretaceous of Mississippi and Georgia. However, Dr. E.J. Petuch (personal communication) is convinced that it falls well outside of even Marginellidae. Petuch and Sargent in 1986 mention it as a possible ancestor to the Olividae. Dr. E.J. Petuch, in a very recent communicate with the author, says ... "However, in retrospect, I don't think that *Myobarum* is ancestral to anything living today, and may be closest to the Cancellariidae ..." he offers, in a different communication: "... and I agree with you; the Marginellidae definitely split off of the Volutidae, probably in the Paleocene, from the same stock that later gave rise to *Amoria*, *Plicoliva*, and *Prochalaea* (an extinct Caribbean group) ----- the subfamily Plicolivinae of the Volutidae, which is a primitive group and a living-fossil left-over, really is closest to the marginellids ---- same kind of protoconch, shiny body, and body shape ---- they also have the ribbed shell sculpture of marginellids like *denticulata* and *mirabilis* ----- so, very similar and a 'missing link' to the ancient volutoidean ancestor ----- hope this helps" (Dr. E.J. Petuch, personal communication).

Coover & Coover stated that although some researchers synonymize the genus *Stazzania* with *Dentimargo*, they considered it to be an extinct, separate lineage, illustrated as such in their intuitively derived phylogeny of the *Marginellini*. (Coover & Coover, 1995, figure 78.) However, in their 2015 paper, Sosso, Brunetti & Dell 'Angelo maintain *Stazzania* as a genus, in agreement with Landau *et al.* 2006, claiming that such genus is so far only found in

the Italian Tortonian (Sosso, Brunetti & Dell 'Angelo, 2015).

## ABBREVIATIONS

CMS	Carlos Marques da Silva Collection
H:	Height
MNHN	Muséum national d'Histoire naturelle, Paris (France)
MNHN/UL	Museu Nacional de Historia Natural da Universidade de Lisboa, Portugal
MZB	Museo di Zoologia dell'Università di Bologna
W:	Width

## KNOWN MEDITERRANEAN FOSSIL SPECIES

In the known investigative literature, fossil records of species of *Marginella*, Lamarck, 1799, can be found as follows:

*Marginella (Stazzania) marginata* Michelotti, 1847 (Plate 1 A-C), ex Italian Tortonian, which are smaller shells (approx. 13 mm), different morphology (rounded shoulder), with some well-preserved patterns of axial 'zig-zag' lines. In similar sized shells, such axial lines can be found in certain deep water Natal species. *e.g.* *Marginella palleukos* Aiken, 2014 (Plate 1 D-I).

*Marginella deshayesi* Michelotti, 1847 (Plate 1 J-O), from the Italian Tortonian, broad, rounded shoulder, denticulate lip. Also type species of "*Denticuloglabella* Sacco, 1890."

*Marginella aurisleporis* (Brocchi, 1814) (Plate 2 A-C). 42 mm very large, smooth, narrow, no pattern.



*Marginella misae* Forli & Dell 'Angelo 2000 (Plate 2 D-F). Large and close to *M. aurileporis*, from a similar fossil area in Italy, ex Pliocene.

*Marginella iberica* Landau, La Perna and Marquet, 2005 (Plate 2 G-K). Approx. 18 mm, west central Portugal, Pliocene, Mondego basin. Narrow shell, with attractive spiral rows of small dark spots in fresher material.

*Marginella seguenzai* La Perna & Vazzana, 2016 (Plate 4 A-C). A presumed deeper water species from the Messina Strait, southern Italy. Plain white shells, bearing a strong resemblance to the deep-water Natal species *Marginella palleukos*, Aiken, 2014 (Plate 4 D-G), and a lot closer than *M. colomborum* (Bozzetti, 1995) (Plate 4 I-J) from the Atlantic sea mounts.

*Marginella stephaniae* da Costa 1866, (Figure 1, Plate 2 L-O, Plate 3 A-L, Plate 8 G-I), Cacela, Algarve. In viewing specimens of '*stephaniae*', it became obvious that the group of about 50 shells were separable into two, an opinion held by Carlos Goncalves for many years. Morphological differences are in evidence in da Costa, Plate XI figs 8-19, and in da Silva *et al.* 2011, figure 4, numbers 1-4 and 5-8. An important piece of information in da Silva *et al.* 2011 is that the type specimen of *M. stephaniae* is lost, therefore a neotype, which will be deposited in Museu Geológico de Lisboa, has been chosen to represent closely the line drawing shell number 11 on Plate 11 of da Costa, 1866, and accordingly *M. stephaniae* is redescribed as follows:

**Description.** Shells large, ranging from 20 to 38 mm, average 30 mm, fairly light, oblong biconical, with rounded shoulder. Spire conical, low, sides of shells gently convex. Surface shiny and smooth. Aperture elongate, fairly broad, external varix thickened ending high

onto the whorl. Labial denticles absent, posterior notch barely noticeable. Strong, continuous columellar pleats, numbering four, occupying in excess of the lower half of the columella, which is virtually straight. Columellar callus thin, parietal callus absent. In good specimens, a golden yellow 'background' colour is overlaid with a fairly random pattern of diffuse, solid, round pale brown spots, which occur in the columellar area, the suture, as well as on the final whorl. The spots average between 1 to 2 mm in diameter and are solid.



Figure 1. *Marginella stephaniae* da Costa, 1866, neotype 26.2 mm.

The descriptions of four new fossil marginellids follow.

## SYSTEMATICS

Class	Gastropoda
Subclass	Caenogastropoda
Order	Neogastropoda
Superfamily	Volutoidea Rafinesque, 1815
Family	Marginellidae J. Fleming, 1828
Subfamily	Marginellinae J. Fleming, 1828
Genus	<i>Marginella</i> Lamarck, 1799



*Marginella goncalvesi* R. Aiken, new species  
(Figure 2, Plates 3M-R, 4H, 5A-R, 8J-L)

**Description.** Shell size medium, average, 24 mm, rarely exceeds 30 mm, extremely broad biconic, strongly built. Spire noticeably depressed, sometimes to the point of almost being flat. Shoulder extremely broad, sharply angled, surface shiny and smooth, albeit sometimes with a series of very close, fine axial growth lines. Aperture relatively narrow, no labial dentition, no posterior notch. Strong, fairly straight external varix, four strong columellar plications, occupying the lower half of the columella, the posterior plication almost at right angles to the whorl. This species presents a distinct, paler, solid, broad columellar and parietal callus that covers the entire columella and carries over onto the previous whorls (Plate 4 H). Colour a uniform straw yellow, but this may be a result of the substrate in which the fossil was embedded. There are distinct, occasional pale brown spots visible only on the latter part of the sutural area of the shell in 'fresher' specimens.

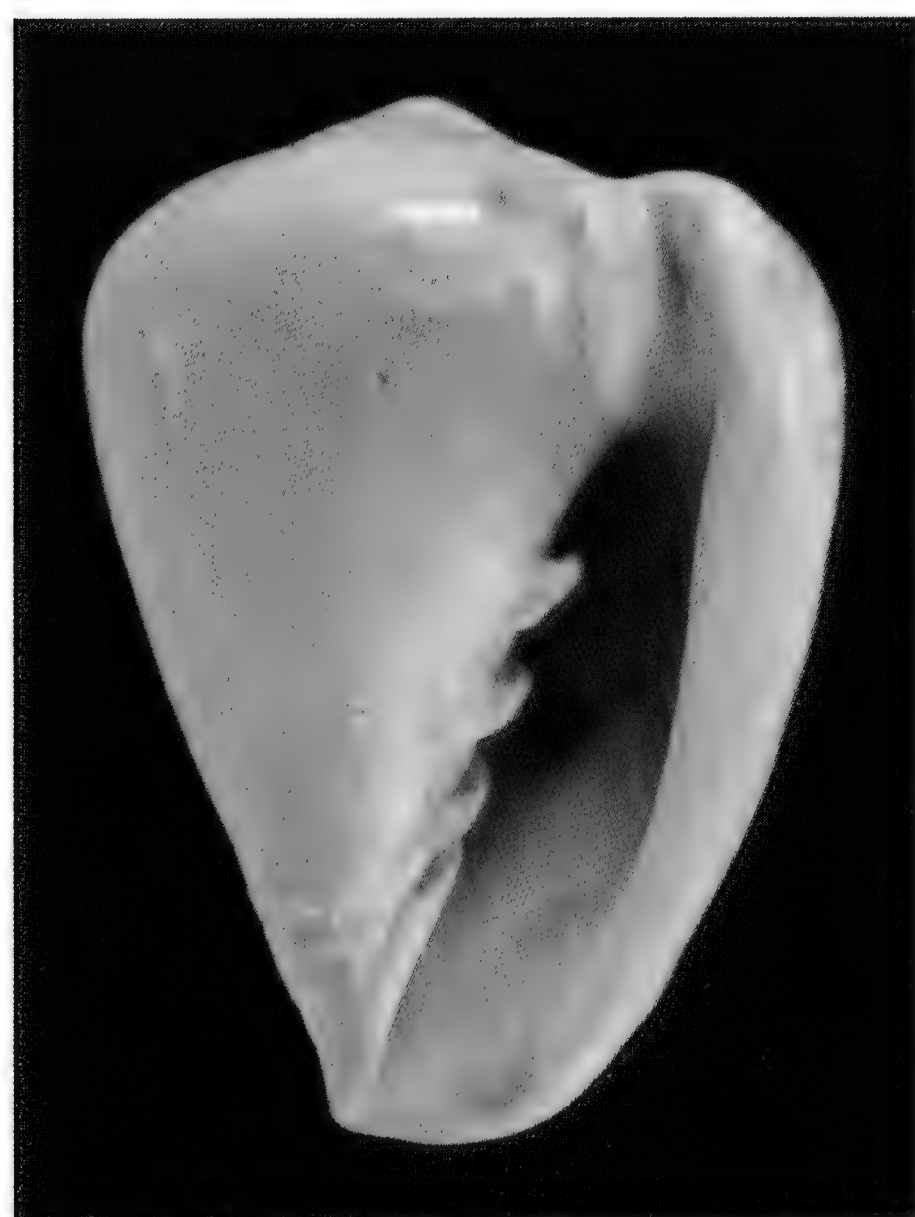


Figure 2. *Marginella goncalvesi* R. Aiken, new species, holotype, length 24.0 mm.

**Type and distribution.** From the Neogene fossil beds of Cacela, Algarve, Portugal.

- Holotype: 24.0 x 18.1 mm. (Plate 5 A-C); Donated to Museu Geológico de Lisboa, collected by R. Aiken.
- Paratype 1: 25.4 x 17.4 mm. R. Aiken Collection.
- Paratype 2: 25.5 x 19.3 mm. R. Aiken Collection.
- Paratype 3: 27.1 x 20.8 mm. C. Goncalves Collection.
- Paratype 4: 23.9 x 18.6 mm. C. Goncalves Collection.
- Paratype 5: 24.5 x 17.4 mm. J. Rosado Collection.
- Paratype 6: 22.9 x 17.3 mm. Ed Petuch Collection.
- Paratype 7: 22.4 x 17.4 mm. A. Seccombe Collection.
- Paratype 8: 22.3 x 17.7 mm. F. Lorenz Collection.
- Paratype 9: 22.4 x 17.6 mm. M. Page Collection.
- Paratype 10: 23.9 x 18.1 mm. R. Aiken Collection.
- Paratype 11: 23.5 x 17.1 mm. R. Aiken Collection.
- Paratype 12: 24.5 x 17.4 mm. R. Aiken Collection.

**Etymology.** I name this species for my conchological friend, Carlos Goncalves, who introduced me to this fascinating group of fossil *Marginella*'s.

**Discussion.** Fortunate exposure to multiple numbers, generating a 'critical mass' of material, which allows for the following comparison of the two sympatric species as follows: *M. stephaniae* attains a much larger size, reaching at least 38 mm. The species has a rounded shoulder, no noticeable parietal callus, a taller



spire, and hardly any columellar callus. *M. stephaniae* has distinct round brown spotting over a much greater part of the shell, even on the columellar area, a consistently broader aperture, curved margin that finishes slightly higher up onto the previous whorl, and a slightly 'lighter' shell.

*Marginella zwartkopsensis* R. Aiken,  
new species (Figure 3, Plates 6A-J, 7P-R)

**Description.** Shell size medium, averaging 26.7 mm. Biconic and solidly built. Spire pointed, shoulder sharply angled, surface of specimens chalky yellow, with no visible pattern. Strong, slightly curved varix, no labial teeth or posterior notch. Aperture fairly wide. Four strong columellar pleats, occupying the lower 60% of the columella. Over all colour of specimens probably influenced by the substrate.



**Figure 3.** *Marginella zwartkopsensis* R. Aiken, new species, holotype, length 26.88 mm.

**Type and distribution.** Located in the Alexandria formation deposits in the Eastern Cape Province, South Africa.

- Holotype: 26.88 x 16.89 mm. (Plate 6 A-C); R. Aiken Collection.  
Paratype 1: 28.41 x 16.92 mm. R. Aiken Collection.  
Paratype 2: 24.78 x 16.59 mm. R. Aiken Collection.  
Paratype 3: 20.62 mm. Fragment. R. Aiken Collection.

**Etymology.** Named for the river and area where some of the Alexandria formation exists.

**Discussion.** *Marginella zwartkopsensis* has size and morphological affinities with *M. stephaniae* and *M. goncalvesi*. All three are purported to have existed in the Neogene, lower Pliocene. None of them have the distinct labial teeth associated with many West African species. The puzzle is that not one single living *Marginella* currently found from off South Africa has round spots of any kind. Although with labial teeth, the extant West African *Marginella goodalli* (Plate 8 A-C) and *Marginella sebastiani* Marche-Marchad, I. & J.C. Rosso, 1979 (Plate 8 D-F) have distinctive attractive white spots on a coloured background, but this is the reverse of *M. stephaniae* (Plate 8 G-I) and *M. goncalvesi* (Plate 8 J-L), which have smaller brown spotting on a yellow grey background. If one looks to living members of this genus, the five species closest to these fossils would be *Marginella mosaica* (Plate 7 A-C), *Marginella bairstowi* (Plate 7 D-F), and *Marginella abyssinebulosa* (Plate 7 G-I), found in Central Eastern Cape, and *Marginella confortini* (Plate 7 J-L) and *Marginella nebulosa* (Plate 7 M-O), from much further west, in False Bay.



*Marginella antepiperata* R. Aiken, new species  
(Figure 4, Plate 9 A-U)

**Description.** Shell size small, ranging from 10.1 to 20.5 mm, biconic, fairly solid, spire high, fairly pointed, shoulder rounded, specimens available are a uniform chalky yellow with no discernible pattern. Varix strong, no labial teeth or posterior notch. Aperture narrow, columellar pleats four, taking up the lower half of the columella.



**Figure 4.** *Marginella antepiperata* R. Aiken, new species, holotype, length 19.69 mm.

**Type and distribution.** Eastern Cape Province, South Africa.

Holotype: 19.69 x 12.21 mm. (Plate 9 A-C); R. Aiken Collection.

Paratype 1: 20.54 x 12.27 mm. R. Aiken Collection.

Paratype 2: 16.25 x 9.81 mm. R. Aiken Collection.

Paratype 3: 12.53 x 8.04 mm. R. Aiken Collection.

Paratype 4: 17.28 mm. Fragment. R. Aiken Collection.

Paratype 5: Width 10.21 mm. Fragment. R. Aiken Collection.

Paratype 6: 14.54 x 8.12 mm. R. Aiken Collection.

Paratype 7: 10.13 x 5.31 mm. R. Aiken Collection.

**Etymology.** Named as a presumed precursor to the *Marginella piperata* group.

**Discussion.** Based on size and morphology, it can be stated with reasonable confidence that this species is the 'grandfather' of most of the group of extant species falling within a broad '*piperata* group', of which the vast majority are found in the Eastern Cape.

*Marginella pseudopoppei* R. Aiken,  
new species (Figure 5, Plates 10A-L, 11M)

**Description.** Shells small to medium in size, ranging from 12.9 to 14.0 mm, biconically shaped, solid, spire fairly pointed, margins strong. No labial teeth or posterior notch. Close, magnified inspection of the dorsum reveals a series of spaced, thin, dark radial lines, on a straw yellow background. The overall shell colour may be influenced by the fossil substrate. Four continuous pleats, covering the lower half of the columella.

**Type and distribution.** From the Pliocene fossil beds of the Alexandria formation, Port Elizabeth, Eastern Cape Province, South Africa.

Holotype: 13.06 x 8.15 mm. (Plate 10 A-C); R. Aiken Collection.

Paratype 1: 12.92 x 7.82 mm. R. Aiken Collection.



Paratype 2: 13.35 x 8.14 mm. R. Aiken Collection.

Paratype 3: 13.98 x 8.91 mm.  
Protoconch missing. R. Aiken Collection.



**Figure 5.** *Marginella pseudopoppei* R. Aiken, new species, holotype, length 13.06 mm.

**Etymology.** Named for the pattern and size similarity to *Marginella poppei*.

**Discussion.** This species is particularly interesting, as it exhibits faintly but quite clearly the characteristic narrow radial dark lines that define a group of extant species that are known from deeper waters off Southern Africa, (*M. diadochus* (Plate 11 A-C) and *M. musica* (Plate 11 D-F)) as well as off West Africa. (*Marginella poppei* Boyer & Neefs, 1999 (Plate 11 G-I) and *Marginella mauretania* Boyer & Neefs, 1999 (Plate 11 J-L)). It is a rare group of marginellids that demonstrates a pattern that is common to both Southern as well as West

African shells, creating the feasibility of a past connection.

## ACKNOWLEDGEMENTS

The author thanks Carlos Goncalves, for bringing material to the authors attention and generous donation of study specimens, and Jose Rosado, for the introduction to Carlos, and great advice on the group. Thanks to Anton Mauve, for injecting a rare kind of enthusiasm in the gathering of much of the South African material. Thanks to Dr. Edward J. Petuch, for invaluable information on the state of the planet during the fossil period under study, and to Mark Page for photography, layout, and valued input as this paper progressed. Thanks to Bruno Dell'Angelo for the provision of images of *Stazzania marginata* (Plate 1 A-C) and *Marginella misae* (Plate 2 D-F, photographer Maurizio Forli). To Jan Neefs for the provision of images of *Marginella mauretania* (Plate 11 J-K). Thanks to Carlos Marques da Silva for permissions to use images of *M. iberica* (Plate 2 G-K). Thanks to Angelo Vazzana and Claire Margerie (Administration for Geodiversitas) for permission to utilize *Marginella sequenza* holotype images (Plate 4 A-C). © Muséum national d'Histoire naturelle, Paris. *Marginella colomborum* (Plate 4 H-I, author Serge Gofas), <http://molluscabase.org/aphia.php?p=image&pic=27031&tid=140321>. Licence at <https://creativecommons.org/licenses/by-nc-sa/4.0/> *Marginella aurisleporis* (Plate 2 A-C, photographer Peter Massicard); Muséum national d'Histoire naturelle, Paris (France), Collection: Paleontology (F), Fossil specimen MNHN.F.J08619. © Licence at <https://creativecommons.org/licenses/by-nc-sa/4.0/>



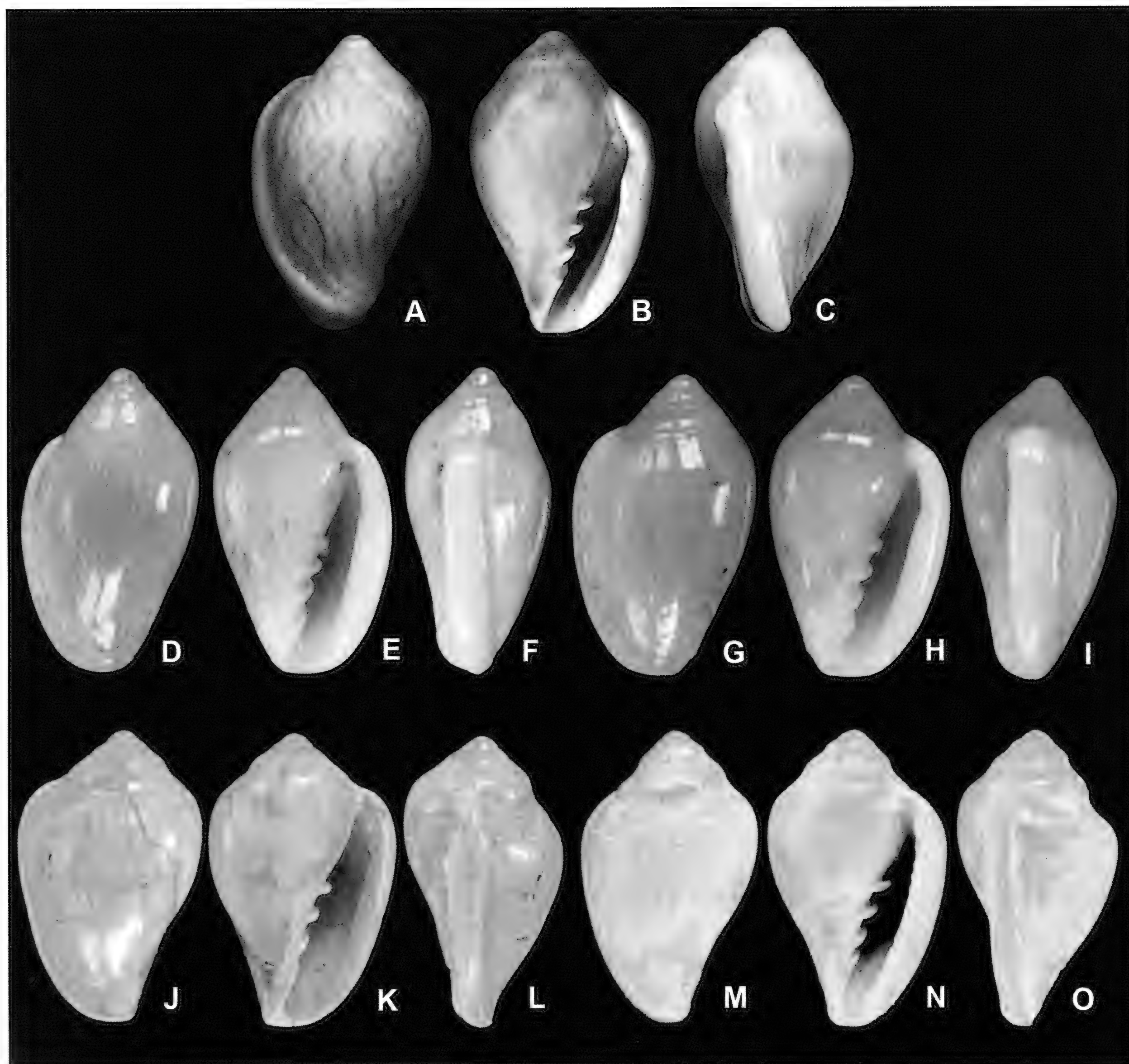
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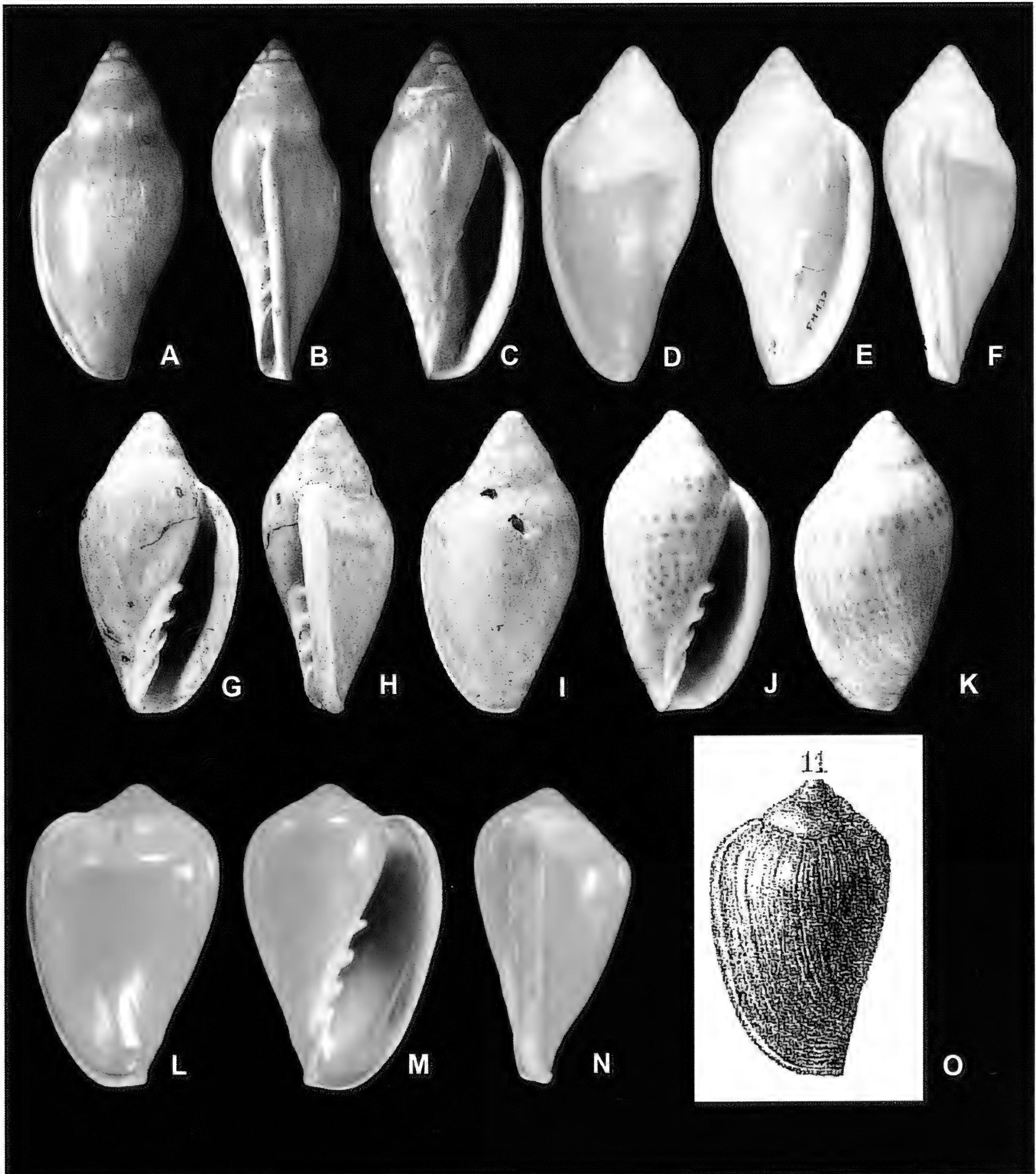
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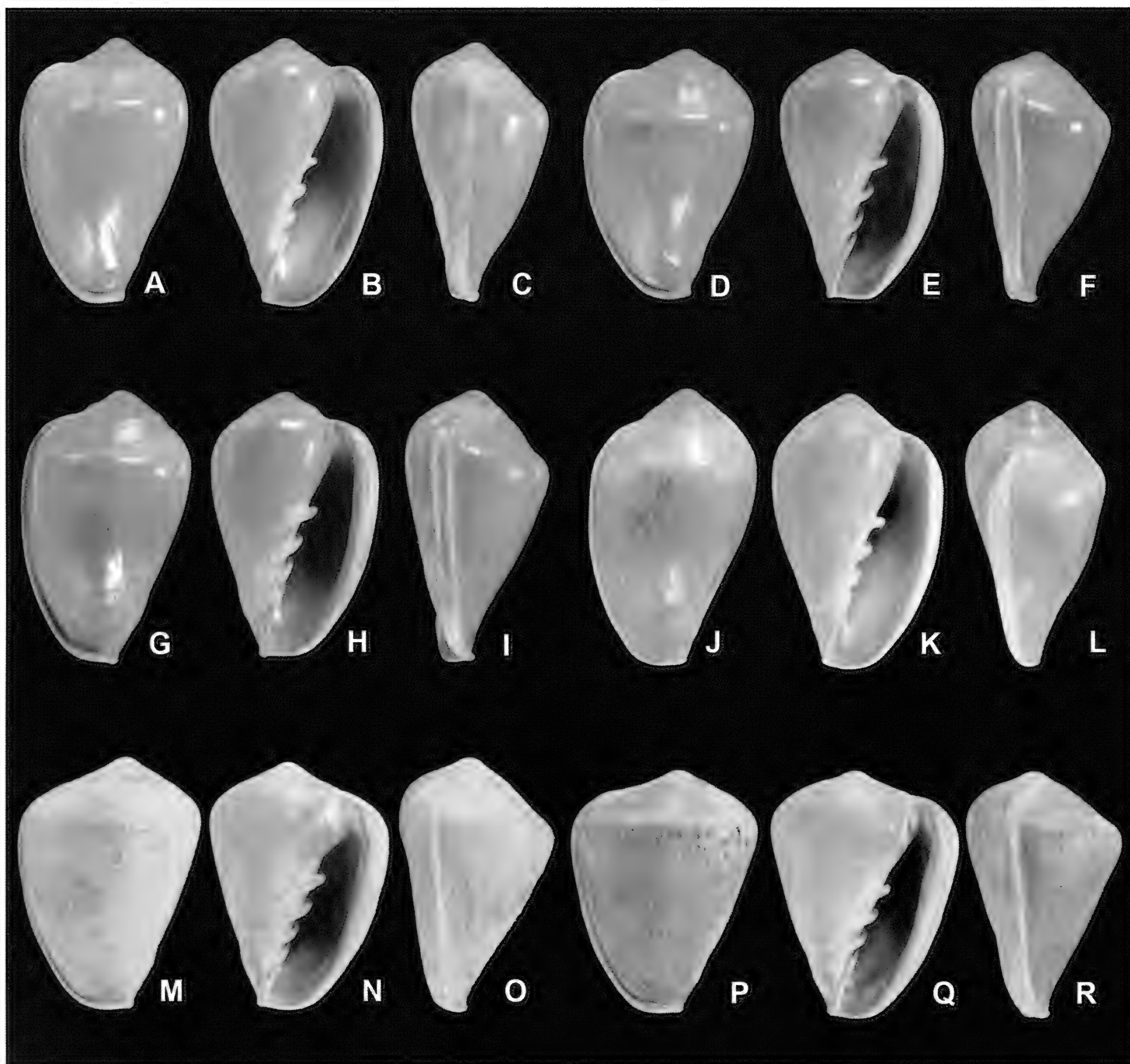
**Plate 1.** Figures: **A-C** = *Stazzania marginata* Michelotti, 1847 (13.38 mm), Rio di Bocca d'Asino, Italy; M. Sosso Collection. **D-F** = *Marginella palleukos* Aiken, 2014 (11.5 x 6.7 mm) - Paratype 12; off Southern KwaZulu-Natal, South Africa; Aiken Collection. **G-I** = *Marginella palleukos* Aiken, 2014 (10.2 x 6.2 mm) - Paratype 5; Off Southern KwaZulu- Natal, South Africa; Aiken Collection. **J-L** = *Marginella deshayesi* Michelotti, 1847 (24.3 x 15.4 mm), Italian Tortonian; Aiken Collection. **M-O** = *Marginella deshayesi* Michelotti, 1847 (26.5 x 17.2 mm), Italian Tortonian; Aiken Collection.





**Plate 2.** Figures: **A-C** = *Marginella aurisleporis* (Brocchi, 1814) (43.1 mm), Italy; Collection MNHN.F.J08619, Photographer Peter Massicard. **D-F** = *Marginella (Marginella) misae* Forli & Dell 'Angelo 2000 (46.8 mm) – Paratype 3; Ciuciano, Tuscany, Italy; Photographer M. Forli. **G-I** = *Marginella iberica* Landau, La Perna and Marquet, 2005 (18.4 mm), Aguas Santas, Mondego Basin; CMS NAD.00.005 Collection. **J-K** *Marginella iberica* Landau, La Perna and Marquet, 2005 (17.3 mm), Aguas Santas, Mondego Basin; CMS VFX.03.358 Collection. **L-N** = *Marginella stephaniae* da Costa 1866 (26.2 x 17.0 mm) - Neotype; Cacela, Algarve, Portugal; Donated to Museu Geológico de Lisboa Collection. **O** = *Marginella stephaniae* da Costa 1866, Cacela, Algarve, Portugal; Type specimen missing.





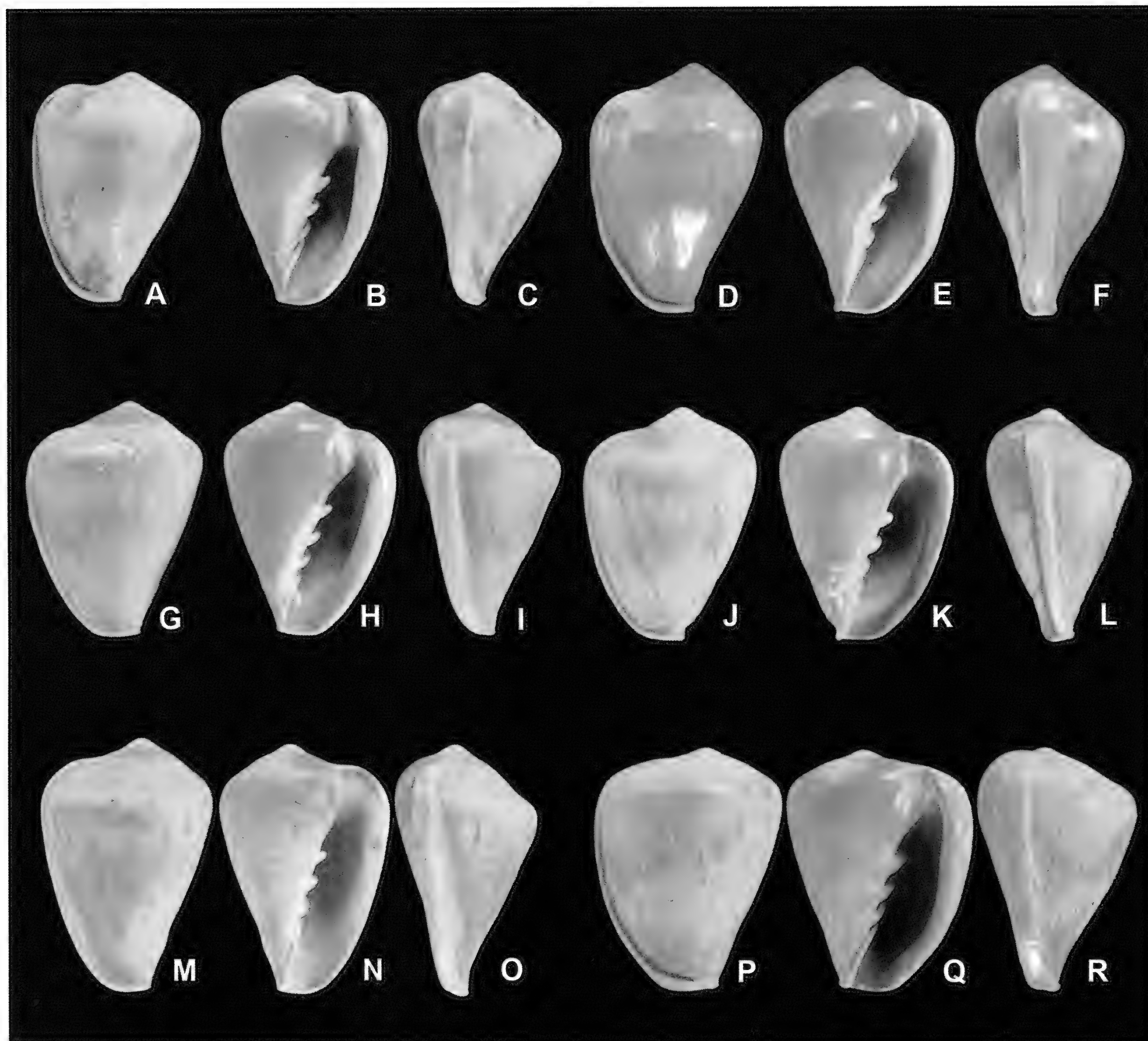
**Plate 3.** Figures: **A-C** = *Marginella stephaniae* da Costa 1866 (26.2 x 17.0 mm) - Neotype; Cacela, Algarve, Portugal; Donated to Museu Geológico de Lisboa Collection. **D-F** = *Marginella stephaniae* da Costa 1866 (26.3 x 17.7 mm), Cacela, Algarve, Portugal; Aiken Collection. **G-I** = *Marginella stephaniae* da Costa 1866 (29.8 x 19.4 mm), Cacela, Algarve, Portugal; Aiken Collection. **J-L** = *Marginella stephaniae* da Costa 1866 (22.3 x 13.9 mm), Cacela, Algarve, Portugal; Aiken Collection. **M-O** = *Marginella goncalvesi* new species (23.5 x 17.1 mm) – Paratype 11; Cacela, Algarve, Portugal; Aiken Collection. **P-R** = *Marginella goncalvesi* new species (22.4 x 17.4 mm) – Paratype 7; Cacela, Algarve, Portugal; Seccombe Collection.





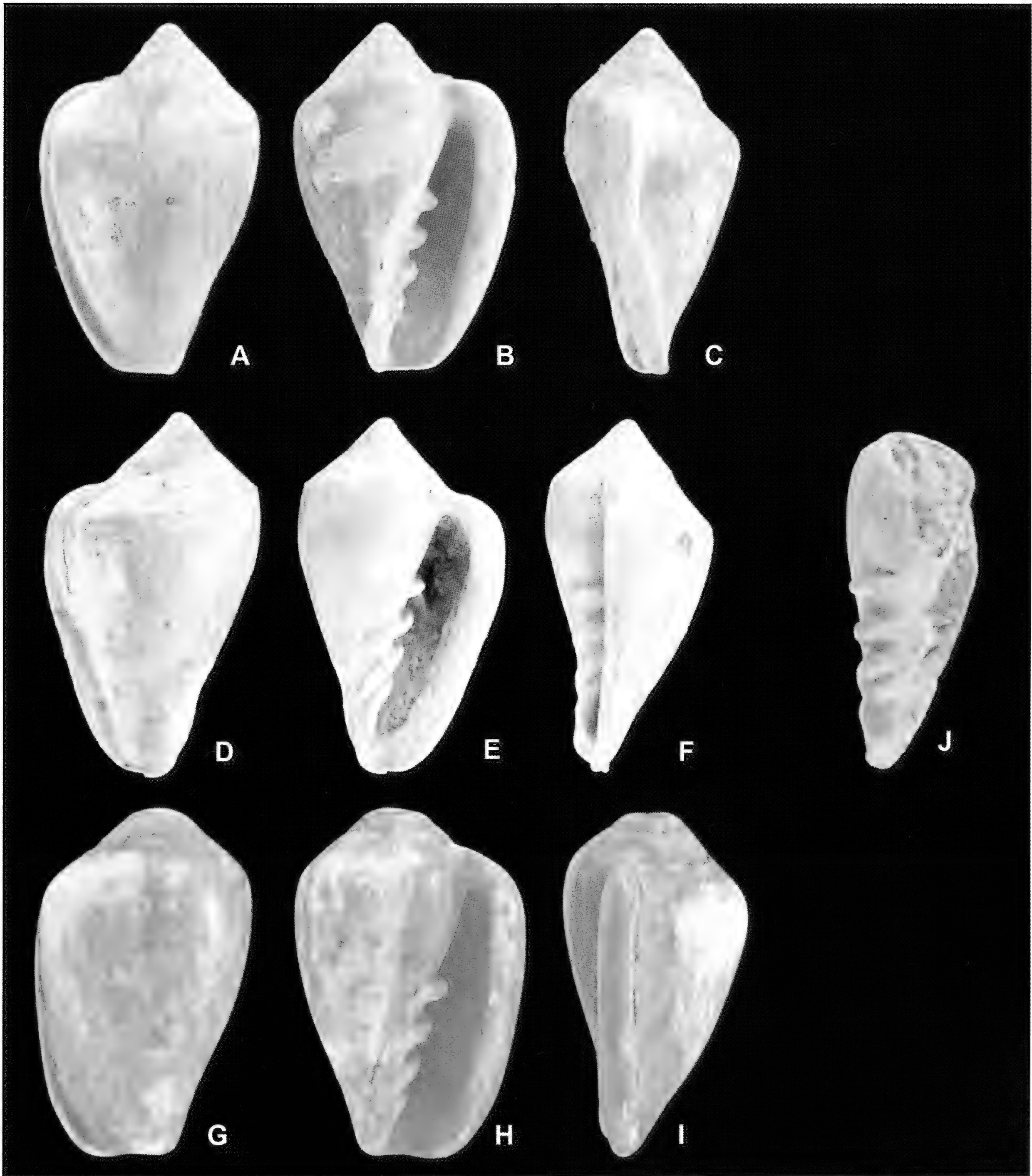
**Plate 4.** Figures: **A-C** = *Marginella seguenza* La Perna & Vazzana, 2016 (9.3 mm) - Holotype; Gallina, Reggio Calabria, Calabrian, Early Pleistocene; MZB60202 collection. **D-E** = *Marginella palleukos* Aiken, 2014; off Southern KwaZulu-Natal, South Africa; Aiken Collection. **F-G** = *Marginella palleukos* Aiken, 2014; Off Southern KwaZulu-Natal, South Africa; Aiken Collection. **H** = *Marginella goncalvesi* new species (25.5 x 19.3 mm) – Paratype 2; Cacela, Algarve, Portugal; Aiken Collection. **I-J** = *Marginella colomborum* (Bozzetti, 1995) (9.7 mm), Josephine seamount. Photographer: Serge Gofas.





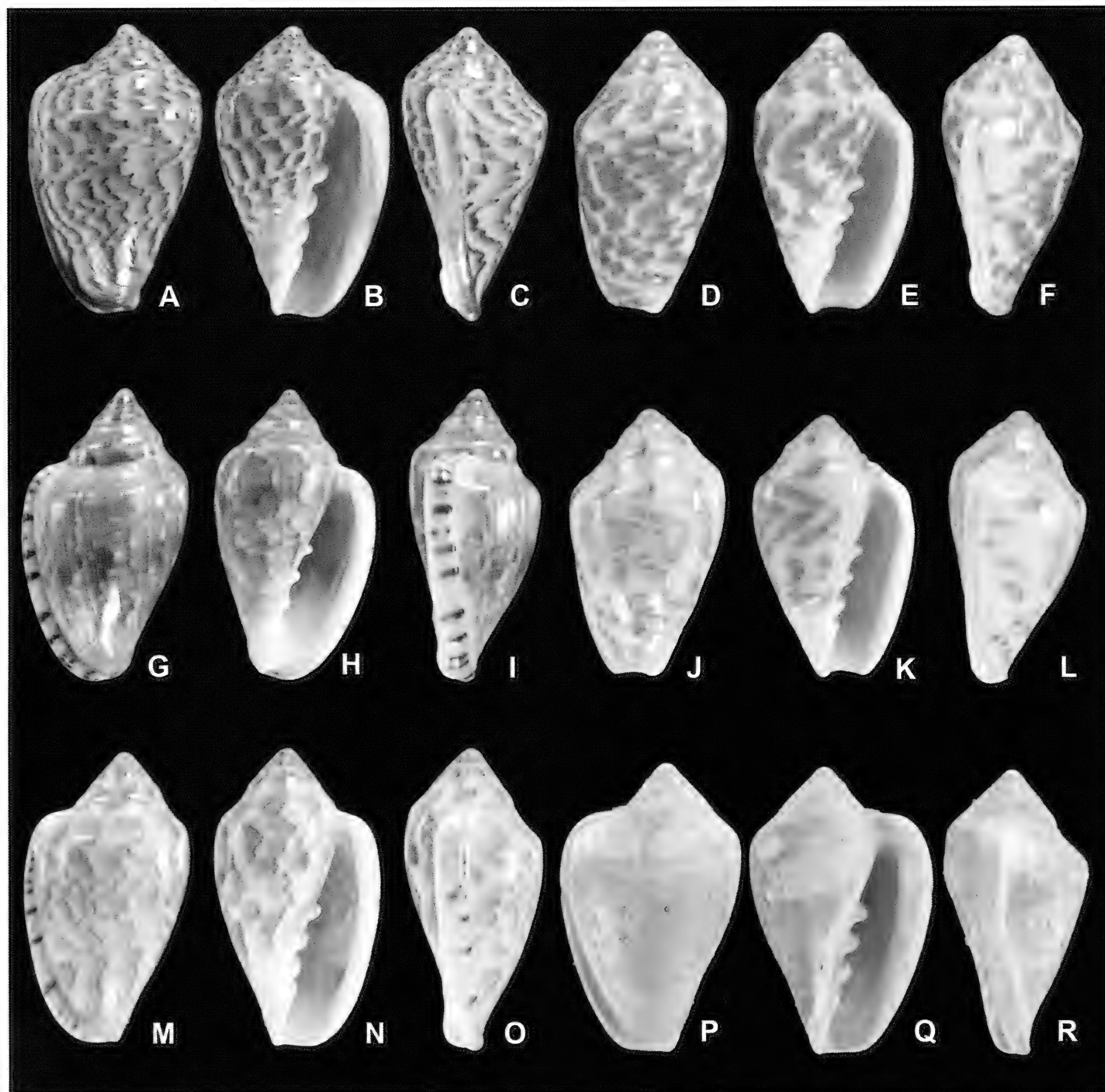
**Plate 5. Figures: 1.** Figures: **A-C** = *Marginella goncalvesi* new species (24.0 x 18.1 mm) - Holotype; Cacela, Algarve basin, Portugal; Donated to Museu Geológico de Lisboa collection. **D-F** = *Marginella goncalvesi* new species (25.4 x 17.4 mm) - Paratype 1; Cacela, Algarve basin, Portugal; R. Aiken Collection. **G-I** = *Marginella goncalvesi* new species (25.5 x 19.3 mm) - Paratype 2; Cacela, Algarve basin, Portugal; R. Aiken Collection. **J-L** = *Marginella goncalvesi* new species (22.9 x 17.3 mm) - Paratype 6; Cacela, Algarve basin, Portugal; Ed Petuch Collection. **M-O** = *Marginella goncalvesi* new species (23.9 x 18.1 mm) - Paratype 10; Cacela, Algarve basin, Portugal; R. Aiken Collection. **P-R** = *Marginella goncalvesi* new species (22.4 x 17.6 mm) - Paratype 9; Cacela, Algarve basin, Portugal; M. Page Collection.





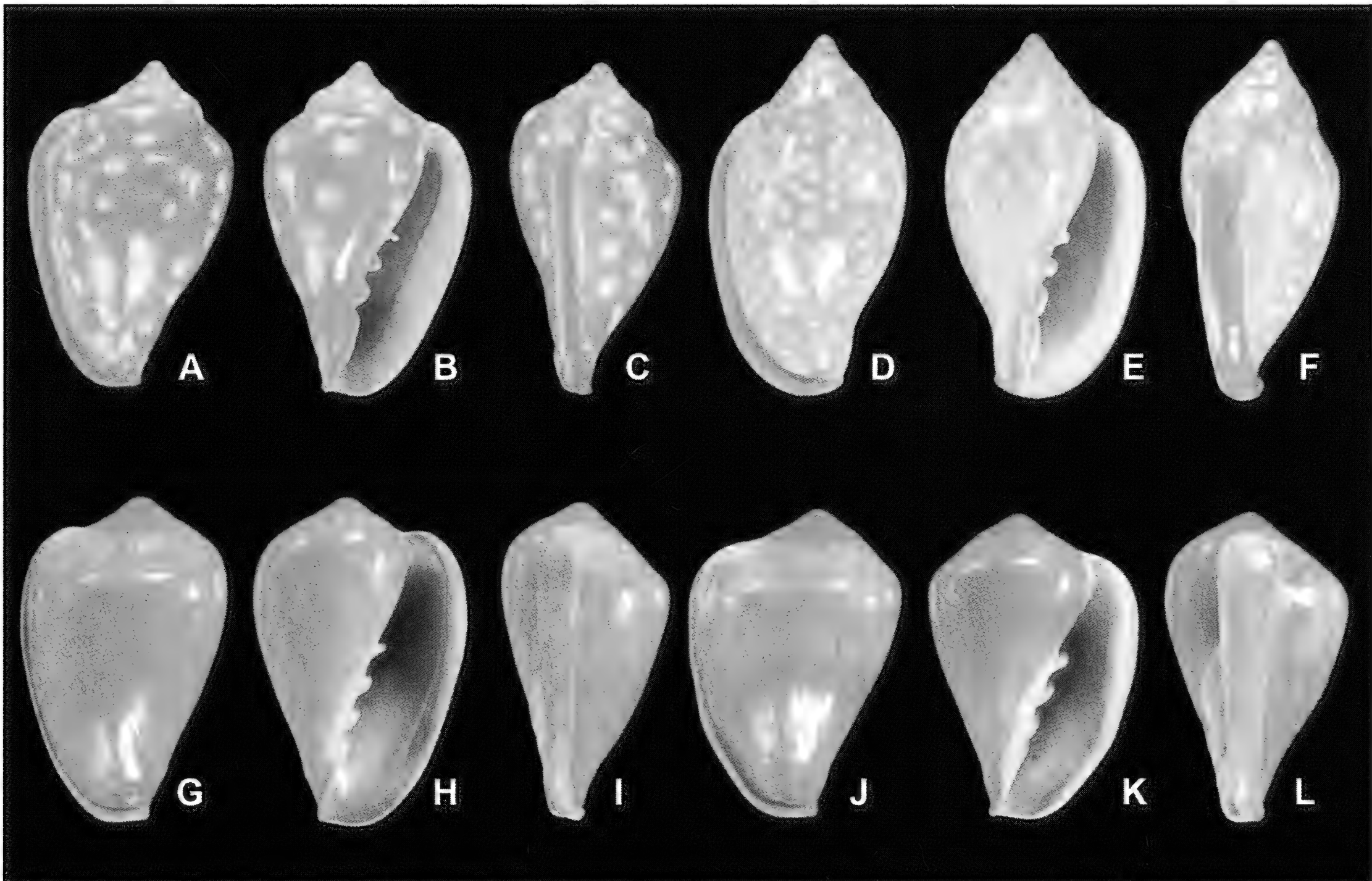
**Plate 6.** Figures: **A-C** = *Marginella zwartkopsensis* new species (26.88 x 16.89 mm) - Holotype; Eastern Cape Province, South Africa; R. Aiken Collection. **D-F** = *Marginella zwartkopsensis* new species (28.41 x 16.92 mm) - Paratype 1; Eastern Cape Province, South Africa; R. Aiken Collection. **G-I** = *Marginella zwartkopsensis* new species (24.78 x 16.59 mm) - Paratype 2; Eastern Cape Province, South Africa; Aiken Collection. **J** = *Marginella zwartkopsensis* new species (20.62 mm) - Paratype 4 fragment; Eastern Cape Province, South Africa; Aiken Collection.



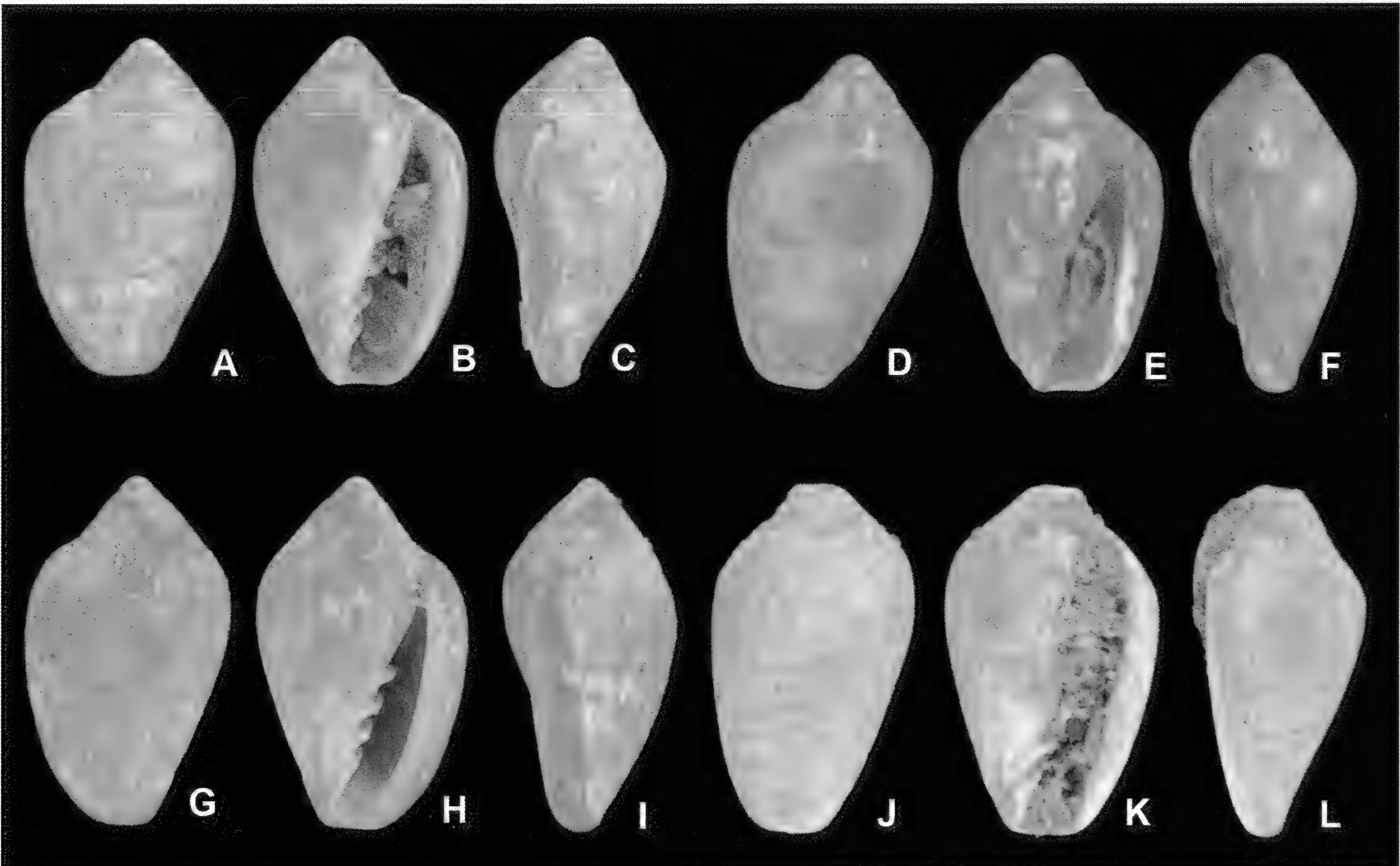


**Plate 7.** Figures: **A-C** = *Marginella mosaica* Sowerby II, 1846 (28.67 x 17.47 mm), Cape St Francis, Eastern Cape Province, South Africa; R. Aiken Collection. **D-F** = *Marginella bairstowi* Sowerby III, 1886 (16.17 x 9.65 mm), East London, Eastern Cape, South Africa; R. Aiken Collection. **G-I** = *Marginella abyssinebulosa* Massier, 2004 (38.81 x 21.53 mm), Cape St Francis, Eastern Cape Province, South Africa; R. Aiken Collection. **J-L** = *Marginella confortini* Bozzetti, 1992 (22.24 x 13.91 mm), False Bay, Western Cape Province, South Africa; R. Aiken Collection. **M-O** = *Marginella nebulosa* (Röding, 1798) (38.04 x 21.78 mm), False Bay, Western Cape Province, South Africa; R. Aiken Collection. **P-R** = *Marginella zwartkopsensis* new species (26.88 x 16.89 mm) - Holotype; Eastern Cape Province, South Africa; R. Aiken Collection.



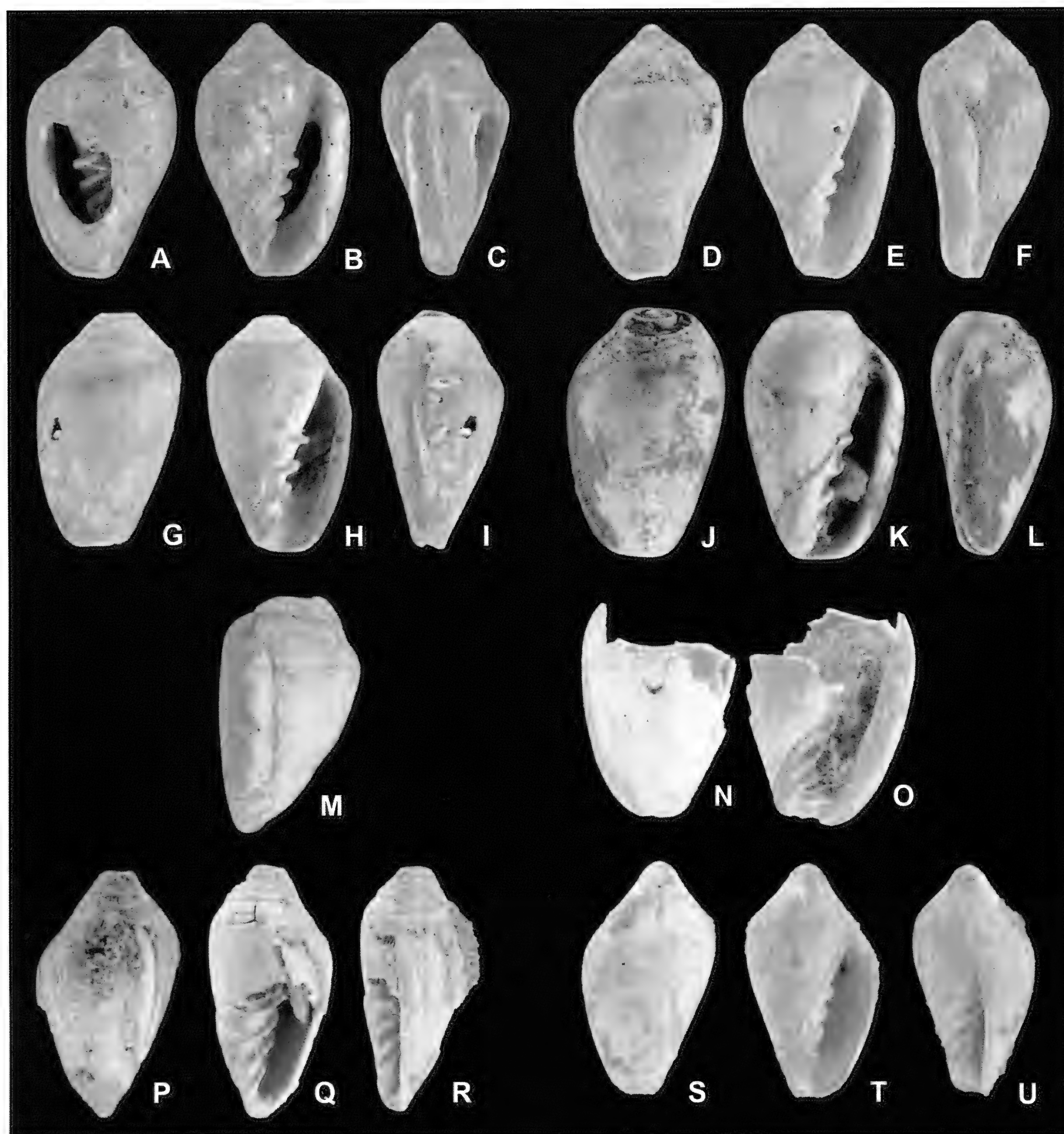


**Plate 8.** Figures: **A-C** = *Marginella goodalli* G. B. Sowerby I, 1825 (36.7 mm), Guinea, Conakry; Aiken collection. **D-F** = *Marginella sebastiani* Marche-Marchad & Rosso, 1979 (41.2 mm), off Dakar, Senegal; Aiken Collection. **G-I** = *Marginella stephaniae* da Costa 1866 (26.2 x 17.0 mm) - Neotype; Cacela, Algarve, Portugal; Donated to Museu Geológico de Lisboa collection. **J-L** = *Marginella goncalvesi* new species (25.4 x 17.4 mm) - Paratype 1; Cacela, Algarve basin, Portugal; R. Aiken Collection.



**Plate 10.** Figures: **A-C** = *Marginella pseudopoppei* new species (13.06 x 8.15 mm) - Holotype; Eastern Cape Province, South Africa; R. Aiken Collection. **D-F** = *Marginella pseudopoppei* new species (12.92 x 7.82 mm) - Paratype 1; Eastern Cape Province, South Africa; R. Aiken Collection. **G-I** = *Marginella pseudopoppei* new species (13.35 x 8.14 mm) - Paratype 2; Eastern Cape Province, South Africa; Aiken Collection. **J-L** = *Marginella pseudopoppei* new species (13.98 x 8.91 mm) - Paratype 3; Eastern Cape Province, South Africa; Aiken Collection.





**Plate 9.** Figures: **A-C** = *Marginella antepiperata* new species (19.69 x 12.21 mm) - Holotype; Eastern Cape Province, South Africa; R. Aiken Collection. **D-F** = *Marginella antepiperata* new species (20.54 x 12.27 mm) - Paratype 1; Eastern Cape Province, South Africa; R. Aiken Collection. **G-I** = *Marginella antepiperata* new species (16.25 x 9.81 mm) - Paratype 2; Eastern Cape Province, South Africa; Aiken Collection. **J-L** = *Marginella antepiperata* new species (12.53 x 8.04 mm) - Paratype 4; Eastern Cape Province, South Africa; Aiken Collection. **M** = *Marginella antepiperata* new species (H: 17.28 mm) - Paratype 5 fragment; Eastern Cape Province, South Africa; R. Aiken collection. **N-O** = *Marginella antepiperata* new species (W: 10.21 mm) - Paratype 6; Eastern Cape Province, South Africa; R. Aiken Collection. **P-R** = *Marginella antepiperata* new species (14.54 x 8.12 mm) - Paratype 7; Eastern Cape Province, South Africa; Aiken Collection. **S-U** = *Marginella antepiperata* new species (10.13 x 5.31 mm) - Paratype 8 Juvenile; Eastern Cape Province, South Africa; Aiken Collection.





**Plate 11.** Figures: **A-C** = *Marginella diadochus* A. Adams and Reeve, 1850 (16.3 x 8.5 mm), Agulhas Bank, South Africa; R. Aiken Collection. **D-F** = *Marginella musica* Hinds, 1844 (20.28 x 10.08 mm), False Bay, Western Cape Province, South Africa; R. Aiken Collection. **G-I** = *Marginella poppei* Boyer & Neefs, 1999 (18.1 mm), 23-25 sea miles west of Western Sahara; R. Aiken Collection. **J-L** = *Marginella mauretanica* Boyer & Neefs, 1999 (18 mm), Off Mauritania; F. Boyer Collection. **M** = *Marginella pseudopoppei* new species (13.06 x 8.15 mm) - Holotype; Eastern Cape Province, South Africa; R. Aiken Collection.



## New Gastropods from Texas, the Western Caribbean, and Southern Brazil

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**ABSTRACT** For inclusion within a new reference text on marine molluscan biogeography, four new gastropods are described here in anticipation of the publication of the book. These include: *Stramonita alderi* n. sp. (Muricidae) from the Texan Subprovince, Carolinian Province; *Turritella* (*Torcula*) *howardpetersi* n. sp. (Turritellidae) and *Prunum sunderlandorum* n. sp. (Marginellidae) from the Nicaraguan Subprovince, Caribbean Province; and *Charonia marylenae* n. sp. (Charoniidae) from the Janeiran Subprovince, Paulinian Province.

**KEY WORDS** Muricidae, Turritellidae, Marginellidae, Charoniidae, Carolinian Province, Caribbean Province, Paulinian Province

### INTRODUCTION

The authors are now in the process of finishing a new reference text on tropical marine molluscan biogeography, slated for publication later this year. While completing the manuscript, four interesting and biogeographically-important new species were brought to our attention by five advanced molluscan field collectors; including Marcus and Jose Coltro (Femorale.com, Italy), Kevan and Linda Sunderland (Florida), and Darwin Alder (Texas). These interesting discoveries from the Western Atlantic Region included a new Triton's Trumpet in the genus *Charonia* from Brazil, a new muricid in the genus *Stramonita* from the coastal lagoons of Texas, a new turritellid in the subgenus *Torcula* from the San Blas Islands of Panama, and a new marginellid in the genus *Prunum* from coastal Honduras. We are incorporating these new biogeographically-important taxa into our new book and they will be illustrated along with 1764 other worldwide tropical mollusks. As no new species will be described in the new book, this paper is the sole

vehicle for the formal taxonomic descriptions and systematics of these gastropods.

The holotypes of three of the new species are deposited in the Los Angeles County Museum of Natural History, Los Angeles, California and bear LACM catalog numbers and one holotype is deposited in the Zoological Museum of the University of São Paulo, São Paulo, Brazil and bears an MZSP catalog number. These new taxa are described in the following sections, which are arranged by biogeographical province and subprovince.

### NEW SPECIES FROM THE TEXAN SUBPROVINCE, CAROLINIAN PROVINCE

The Texan Subprovince is one of five subprovinces of the Carolinian Molluscan Province, which ranges from Cape Hatteras, North Carolina, through the Florida Keys, and includes the entire Gulf of Mexico to Isla Mujeres off the Yucatan Peninsula. The Texan Subprovince extends from the Mississippi



River mouth south to Veracruz, Mexico and includes the entire coastline of Texas (Petuch, 2013: at pp. 16, 65-69).

## SYSTEMATICS

Class	Gastropoda
Subclass	Orthogastropoda
Superorder	Caenogastropoda
Order	Sorbeoconcha
Infraorder	Neogastropoda
Superfamily	Muricoidea
Family	Muricidae
Subfamily	Rapaninae
Genus	<i>Stramonita</i> Schumacher, 1817

*Stramonita alderi* Petuch and Berschauer,  
new species  
(Figure 1A, B)

**Description.** Shell subfusiform, biconic, with inflated body whorl and high, elevated spire; shoulder sharply-angled, bordered by 10 evenly-spaced, large rounded knobs; subsutural area of shoulder and spire whorls sloping, slightly concave; body whorl heavily sculpted with 24 large raised spiral cords, with 2 largest cords encircling shoulder and around mid-body and bearing 10 proportionally very large rounded knobs; spiral cords intersected by 10 widely-spaced, low, rounded longitudinal varices, with intersections producing small, rounded knobs on larger spiral cords; aperture proportionally very large and flaring; inner edge of labrum with 16 thin, elongated teeth (on holotype); shell base color bright yellow-orange, overlaid with variable amounts of dark blackish-brown longitudinal flammules, primarily on the varices, producing a zebra-type pattern; large rounded knobs at intersections of varices and spiral cords often colored bright orange; early whorls dark chocolate brown; columellar area and entire aperture pale orange, becoming pale yellow-orange along edge of labrum.

**Type Material.** HOLOTYPE - Length 33.8 mm, width 21.6 mm, Mustang Island, Corpus Christi, Nueces County, Texas, LACM 3800.

**Type Locality.** Found dead on an oyster-covered rock at low tide, carried by a hermit crab, Mustang Island Jetty at the mouth of Fish Pass, Mustang Island, Corpus Christi, Nueces County, Texas.

**Distribution.** Known only from jetties and rock outcrops along the coastal lagoons and estuaries of Texas. Tunnell *et al.* (2010: at p. 212) states that *S. alderi* prefers “hard substrates; usually rocks or jetties exposed to the ocean at depths of 0-4 m.”

**Etymology.** Named for Darwin Alder of Houston, Texas, who collected the holotype.

**Discussion.** This small but distinctive muricid has previously been referred to as “*Stramonita* cf. *rustica* (Lamarck, 1822)” by Tunnell *et al.* (2010: at p. 212) in their book Encyclopedia of Texas Seashells. Their photographs were the only known color illustrations of this elusive mollusk and little is known about its range and relative abundance along the Texas coastal lagoon systems. The inclusion of this *Stramonita* species within the Texas malacofauna is also of interest, as *S. rustica* had previously only been known from Florida, the Caribbean Sea, and Brazil (Clench, 1947: at p. 82; Abbott, 1974: at p. 180) and was not considered, classically, to be part of the Texan coastal fauna (a typical specimen of *Stramonita rustica* is shown here on Figure 1E, F for comparison). True *S. rustica* consistently has a pure white aperture, which contrasts greatly with the pale orange aperture seen in *S. alderi* (Figure 1B). The new Texas species also has a much more colorful and ornate shell, being ornamented with stronger and more prominent spiral cords and in having prominent bright



yellow-orange bands containing darker orange knobs. The shell ornamentation of *S. rustica* is much more reduced and less-developed, consisting of low thread-like cords and small, rounded knobs, and it is a much drabber shell, being colored in shades of brown and gray and lacking the bright orange bands and knobs of *S. alderi*. The new Texas species also has finer and more numerous teeth within the aperture than does *S. rustica*, numbering 16 on the holotype as opposed to 8-10 on typical *S. rustica* specimens.

The new Texas muricid is actually morphologically closest to the southeastern Florida endemic, *S. buchecki* Petuch, 2013 (Figure 1C, D), which also has a distinctive orange aperture. This small, previously overlooked, species inhabits coastal lagoons and tidal creeks all along southeastern Florida, from Martin County south to Broward County, and is found in the same type of oyster bed environments that are preferred by *S. alderi*. The Florida endemic differs from its Texan congener in having a less-sloping shoulder and spire whorls, in having a more strongly-stepped and scalariform spire that is ornamented with larger knobs, in having large patches of blue and olive-green on the body whorls, and in lacking the prominent orange bands and knobs. *Stramonita buchecki* also differs from *S. alderi* in having fewer and proportionally larger apertural teeth, averaging only 7-8 on most specimens. Both the Texan *S. alderi* and the Floridian *S. buchecki* occur together on oyster beds with the larger, and more widespread Carolinian Province *S. floridana* (Conrad, 1837). These two Carolinian Province endemics, along with the widespread *S. rustica* and the St. Helena and Ascension Island endemic *S. bicarinata*, form a species radiation of small rapanines that co-exists with, but is different from, the larger *Stramonita* species such as those typified by *S. haemostoma* (Linnaeus,

1767), *S. floridana*, and *S. brasiliensis* Claremont and Reid, 2011. The *S. rustica* complex may eventually prove to be a separate subgenus all to itself.

### NEW SPECIES FROM THE NICARAGUAN SUBPROVINCE, CARIBBEAN PROVINCE

The Nicaraguan Subprovince is one of seven subprovinces of the Caribbean Molluscan Province, which ranges from Bermuda and the Bahamas south to the mouth of the Amazon River, and encompasses all of the island archipelagoes of the Caribbean basin. The Nicaraguan Subprovince extends from Guatemala to the San Blas Islands of Panama, and encompasses all the banks and island chains off the coasts of Honduras and Nicaragua (Petuch, 2013: at p. 20, 97-112).

### SYSTEMATICS

Class	Gastropoda
Subclass	Orthogastropoda
Superorder	Caenogastropoda
Order	Sorbeoconcha
Infraorder	Mesogastropoda
Superfamily	Cerithioidea
Family	Turritellidae
Genus	<i>Turritella</i> Lamarck, 1799
Subgenus	<i>Torcula</i> Gray, 1847

*Turritella (Torcula) howardpetersi* Petuch and  
Berschauer, new species  
(Figure 2A, B)

**Description.** Shell small for genus, thin and delicate, elongated and pagodiform, with narrow early whorls widening toward anterior end; suture tightly adherent; whorls ornamented with 2 large, thin spiral cords, one on either side of central depressed sulcus; anterior cord proportionally larger and more prominent than posterior cord, giving shell distinct pagoda or



stupa shape; edges of cords faintly nodulose, being ornamented with very numerous tiny rounded beads; area between cords smooth and silky, sculptured with very numerous, extremely fine spiral threads; last whorl on adult shells wider than previous whorls, with prominent large longitudinal laminae developing within central sulcus; base shell color dark tan or brown, with scattered large areas of darker purple-brown; edges of thin spiral cords marked with tiny brown dots and dashes; protoconch and early whorls uniformly orange-tan; aperture proportionally large, roughly rectangular in shape, flaring; interior of aperture pale tan.

**Type Material.** HOLOTYPE - Length 37.5 mm, width 10.4 mm, off Porvenir, San Blas Islands, Panama, LACM 3801; OTHER MATERIAL EXAMINED - length 35.3 mm, from the same locality as the holotype, in the research collection of the senior author; length 36.9 mm and 36.7 mm, from the same locality as the holotype, in the research collection of the junior author; length 36 mm, in the collection of Howard Peters, Bath, England, UK.

**Type Locality.** The type lot was dredged by shrimpers from 35 m depth off El Porvenir, San Blas Islands, Panama.

**Distribution.** Known only from deeper offshore areas along the San Blas Archipelago of Caribbean Panama.

**Etymology.** The taxon honors Dr. Howard Peters of Bath, Somerset, England and the University of York, a member of the molluscan assessment group for the IUCN Red List of Threatened Species. His hard work and dedication have provided much-needed protection for numerous critically endangered species of cone shells and abalones from around the world.

**Discussion.** The subgenus *Torcula* represents a group of endemic American turritellids that characteristically have a sculpture pattern composed of two strong cords on each whorl and a deep central depressed sulcus between the cords. In the western Atlantic, four species of *Torcula* are now known to exist: the wide-ranging *Turritella (Torcula) exoleta* (Linnaeus, 1758) (Figure 2C), which occurs in the Carolinian, Caribbean, and Brazilian Molluscan Provinces; and three species that are restricted to the Nicaraguan Subprovince of the Caribbean Province, *T. (Torcula) marianopsis* Petuch, 1990 (San Blas Islands of Panama), *T. (Torcula) bayeri* Petuch, 2001 (deep reefs off Honduras), and *T. (Torcula) howardpetersi* (San Blas Islands of Panama). Of these, the new San Blas Islands species is morphologically closest to *T. (Torcula) exoleta*, but differs in being a smaller and more delicate shell with a shorter, squatter, and less elongated profile. On *T. (Torcula) exoleta*, the two main cords on each whorl are equal in size and development (seen here on Figure 2C), while those of *T. (Torcula) howardpetersi* are unequal, with the anterior cord being much larger than the posterior one and dominating the shell outline. The new San Blas Islands turritellid lives together with the larger and more elongated *T. (Torcula) marianopsis*, but is a much more abundant species and is more frequently collected. Together, these detritus-eating turritellids form large, extensive beds that literally carpet the sea floor in many deep offshore areas of the San Blas region.

## SYSTEMATICS

Class	Gastropoda
Subclass	Orthogastropoda
Superorder	Caenogastropoda
Order	Sorbeoconcha
Infraorder	Neogastropoda
Superfamily	Volutoidea
Family	Marginellidae



Genus *Prunum* Herrmannsen, 1852

*Prunum sunderlandorum* Petuch and  
Berschauer, new species  
(Figure 2D, E)

**Description.** Shell small for genus and species group, averaging only around 12 mm, elongate and oval, almond-shaped, widest across shoulder and tapering toward anterior end; shoulder rounded, blending directly into body whorl; spire whorls low, broadly pyramidal; edge of labrum thickened, rounded, extending posteriorly beyond penultimate whorl; body whorl base color uniform dark slate gray with wide, darker blue-gray band around midbody; broad midbody band darker at both posterior and anterior edges, producing 2 thin darker parallel bands; subsutural area of body whorl bounded by thin band of cream-white; spire whorls dark reddish-brown, with sutures edged in white; early whorls and protoconch dark orange-red; edge of labrum white, marked along dorsal edge with dark yellow-orange stripe; protoconch broad, low, dome-shaped, composed of 2 whorls; aperture proportionally narrow, widening slightly toward anterior end; columella with 4 large, rounded teeth, with anteriormost pair of teeth being closest together; interior of aperture colored dark reddish-brown.

**Type Material.** HOLOTYPE - Length 12.6 mm, width 7.3 mm, 5 m depth, Trujillo Bay, Trujillo, Honduras, LACM 3802; OTHER MATERIAL EXAMINED - length 11.3 mm and 12.4 mm, from the same locality and depth as the holotype, in the research collection of the senior author; length 11.7 mm and 11.6 mm, from the same locality and depth as the holotype, in the research collection of the junior author; lengths 11.5 mm and 12.2 mm, from the same locality and depth as the holotype, in the Sunderland collection.

**Type Locality.** In muddy sand, 5 m depth in Trujillo Bay, off Trujillo, Departamento de Colon, Honduras.

**Distribution.** At present, known only from the Caribbean coast of Honduras, along the area opposite the Bay Islands of Utila, Roatan, and Guanaja.

**Etymology.** Named for Kevan and Linda Sunderland of Sunrise, Florida, who collected the type lot of the new species in Honduras, and also in recognition of their many important contributions to our knowledge of Caribbean malacology.

**Discussion.** *Prunum sunderlandorum* is the newest known member of a tightly-knit species complex of gray-colored marginellids that is found along the coastal areas of the western and southern Caribbean. Some of these include the widespread southern Caribbean *Prunum prunum* (Gmelin, 1791), the Honduran and Nicaraguan *P. storeria* (Couthouy, 1837), and the Panamanian *P. leonardhilli* Petuch, 1990. Of these, *P. sunderlandorum* is by far the smallest species, averaging less than half the length of the other three larger taxa. Of the members of this complex, the new species is closest to *Prunum leonardhilli* (Figure 2F), but differs in being a much smaller and more slender shell, in having the widest part of the shell being around the shoulder and not the mid-body like in *P. leonardhilli*, in being a much more darkly-colored shell with a dark slate-gray base color as opposed to pale bluish-gray, and in having the labrum extend farther posteriorly, with the lip of *P. sunderlandorum* extending onto the penultimate whorl and with the lip of *P. leonardhilli* extending only to the shoulder line.



## NEW SPECIES FROM THE JANEIRAN SUBPROVINCE, PAULINIAN PROVINCE

The Paulinian Province was originally described as a subprovince of the Brazilian Province (Petuch, 2013: at p. 146, 163-175). Additional research and data has subsequently shown that this area contains a very distinct warm-temperate fauna and is here (and in the new book) considered to represent a full biogeographical province all to itself. The Paulinian Province has been further subdivided into two separate subprovinces; a northern Janeiran Subprovince (Cabo Frio south the Florianopolis) and a southern Uruguayan Subprovince (Florianopolis south to northern Argentina). This Paulinian Province will be described, and much of its fauna illustrated, in the up coming biogeography book.

### SYSTEMATICS

Class	Gastropoda
Subclass	Orthogastropoda
Superorder	Caenogastropoda
Order	Sorbeoconcha
Infraorder	Mesogastropoda
Superfamily	Tonnoidea
Family	Charoniidae
Genus	<i>Charonia</i> Gistel, 1847

*Charonia marylenae* Petuch and Berschauer,  
new species  
(Figure 3A, B)

**Description.** Shell of average size for genus, elongated, with inflated body whorl and high, elevated spire; shoulder sharply-angled, with flattened, tabulate subsutural areas; shoulder bounded by large, rounded cord and ornamented with 10-12 large, rounded knobs; spire whorls distinctly stepped and scalariform, with spire length being longer than body whorl length; body whorl ornamented with 32-36 fine, closely-packed rows of fine raised spiral cords;

mid-body ornamented with large knobbed cord that aligns to knobbed shoulder cord, producing a bituberculate appearance; suture bordered by 6 smooth raised cords; siphonal canal short, stubby, ornamented with 12-14 large raised cords; varices widely scattered, usually one per whorl, low, thick, with large knob at posterior end; aperture proportionally large, flaring, oval in shape; columella with large, well developed parietal shield and numerous elongated plicae; posterior end of columella with single large rib-like fold; labrum well developed, flaring, expanded, edged with 16-18 large elongated teeth, some of which bifurcate; shell color variable, ranging from brown to purple-brown to orange or yellow (as in holotype); base color overlaid with variable amounts of brown dashes and dots and small brown flammules; shoulder and mid-body knobs marked with alternating large brown and white spots and patches; cords around suture conspicuously marked with alternating vivid dark brown and white dashes; interior of aperture white; teeth on edge of labrum colored dark brown with intervening white spaces; plicae of parietal shield white with intervening dark brown staining.

**Type Material.** HOLOTYPE - Length 119.6 mm, width 59.4 mm, 50 m depth off Cabo Frio, Rio de Janeiro State, Brazil (MZSP 150892); OTHER MATERIAL EXAMINED - length 259 mm, from the same locality and depth as the holotype, in the research collection of the senior author; length 210 mm, from the same locality and depth as the holotype, in the collection of Marcus and Jose Coltro, São Paulo, Brazil.

**Type Locality.** Trawled by fishermen from 50 m depth off Cabo Frio, Rio de Janeiro State, Brazil.

**Distribution.** At present, known only from an area extending from the Cabo Frio area of



northern Rio de Janeiro State, south to off Rio de Janeiro, Brazil.

**Etymology.** The new taxon honors Marylena Francisquini Coltro of São Paulo, Brazil and Miami, Florida, an inspired amateur naturalist with a deep fascination for the marine world. She cultivated this passion within her children, Sabrina, Marcus, and Jose Coltro (owners of Femorale.com shell company), which led them to pursue lifetimes of field work and discovery.

**Discussion.** *Charonia marylenae* is the newest member of a worldwide complex of closely related warm-temperate water triton shells. Besides the new Brazilian taxon, seven other species belong to this complex and these include: *Charonia lampas* (Linnaeus, 1758) (Mediterranean Sea and West Africa); *C. capax* (Finlay, 1927) (New Zealand); *C. pustulata* (Euthyme, 1889) (South Africa); *C. rubicunda* (Perry, 1811) (South and SE Australia); *C. powelli* Cotton, 1957 (South Australia, Tasmania); *C. sauliae* (Reeve, 1844) (Japan, Taiwan); and *C. macilenta* Kuroda and Habe, 1961 (Ryukyu Islands, South China Sea, Vietnam). All of these charoniids are closely related to, and are typified by, the Mediterranean Sea-West African *Charonia lampas* and most have previously been considered subspecies or forms of that wide-ranging Eastern Atlantic triton. We here consider them all to be full species, along with the Brazilian *C. marylenae*. Referred to here as the “*Charonia lampas* Complex”, this group of charoniids forms a separate lineage that diverged away from the typical charoniid species group that defines the family, containing *Charonia tritonis* (Linnaeus, 1758) (widespread Indo-Pacific), *C. variegata* (Lamarck, 1816) (western Atlantic, central Atlantic), and *C. seguenzeae* Aradas and Benoit, 1874 (eastern Mediterranean).

Of the known members of the *Charonia lampas* Complex, *C. marylenae* is morphologically closest to *C. pustulata* from South Africa (Figure 3C). Indeed, past workers (including the senior author; Petuch, 2013: at p. 167) have often referred to the Brazilian shell as “*Charonia lampas pustulata*” and considered it to be simply a biogeographical and genetic outlier of the South African triton. With the availability of more specimens for study, it is now apparent that the Brazilian shell is morphologically and biogeographically distinct and needs a new name. Although superficially similar to *Charonia pustulata*, the new Brazilian shell differs in having a narrower and less inflated body whorl, in having a proportionally higher and narrower spire, in having a much more stepped spire with distinctly tabulate and flattened whorls, and in having fewer and finer cords around the subsutural area. In having a very high, protracted spire, *C. marylenae* somewhat resembles the elongated South Australian *C. powelli*, but differs in having a more stepped spire, in having proportionally much larger knobs on the shoulder and around the mid-body, and in having stronger cords around the body whorl.

The new species has also been referred to the taxon “*Charonia weisbordi* Gibson-Smith, 1976” by some workers and the name is essentially problematic. The true *C. weisbordi* is a rare Pliocene fossil from the Mare Formation of northern Venezuela and it bears only a superficial resemblance to *C. marylenae*. The Venezuelan fossil has only been illustrated by Weisbord (1962; broken fragments) and by Gibson-Smith (1976; an incomplete broken specimen) but they show that the Pliocene species is a smaller and more inflated species, has smaller and less-developed shoulder and mid-body knobs, and has reduced spiral cords on the body whorl. Without doubt, *C. weisbordi* represents the Pliocene ancestor of the living *C.*



*marylenae* and demonstrates that members of the *Charonia lampas* Complex were already present in South America at least 3.5 million years ago.

The new triton is a component of a species rich cool water fauna, filled with endemic taxa, that has evolved in the Cabo Frio area of northern Rio de Janeiro State, from Arraial do Cabo northward to Farol de São Tome. Here, large and powerful upwellings of cold, nutrient-rich water are brought up to the surface, and these allow dense phytoplankton blooms to form and support cold tolerant scleractinian corals and hydrocorals. Seven species of scleractinian corals and two species of hydrocorals flourish in the Cabo Frio region and form small, scattered patch reefs all along the coast (referred to as the "Coral Oasis"; see Leao, Kikuchi, and Testa, 2003). These cooler-water reefs and coral bioherm areas support numerous endemic gastropods, including the triton *Charonia marylenae*, the cone shells *Lamniconus petestimpsoni* and *L. patriceae*, and the volutes *Odontocymbiola macaensis* and *O. saotomensis*.

## ACKNOWLEDGMENTS

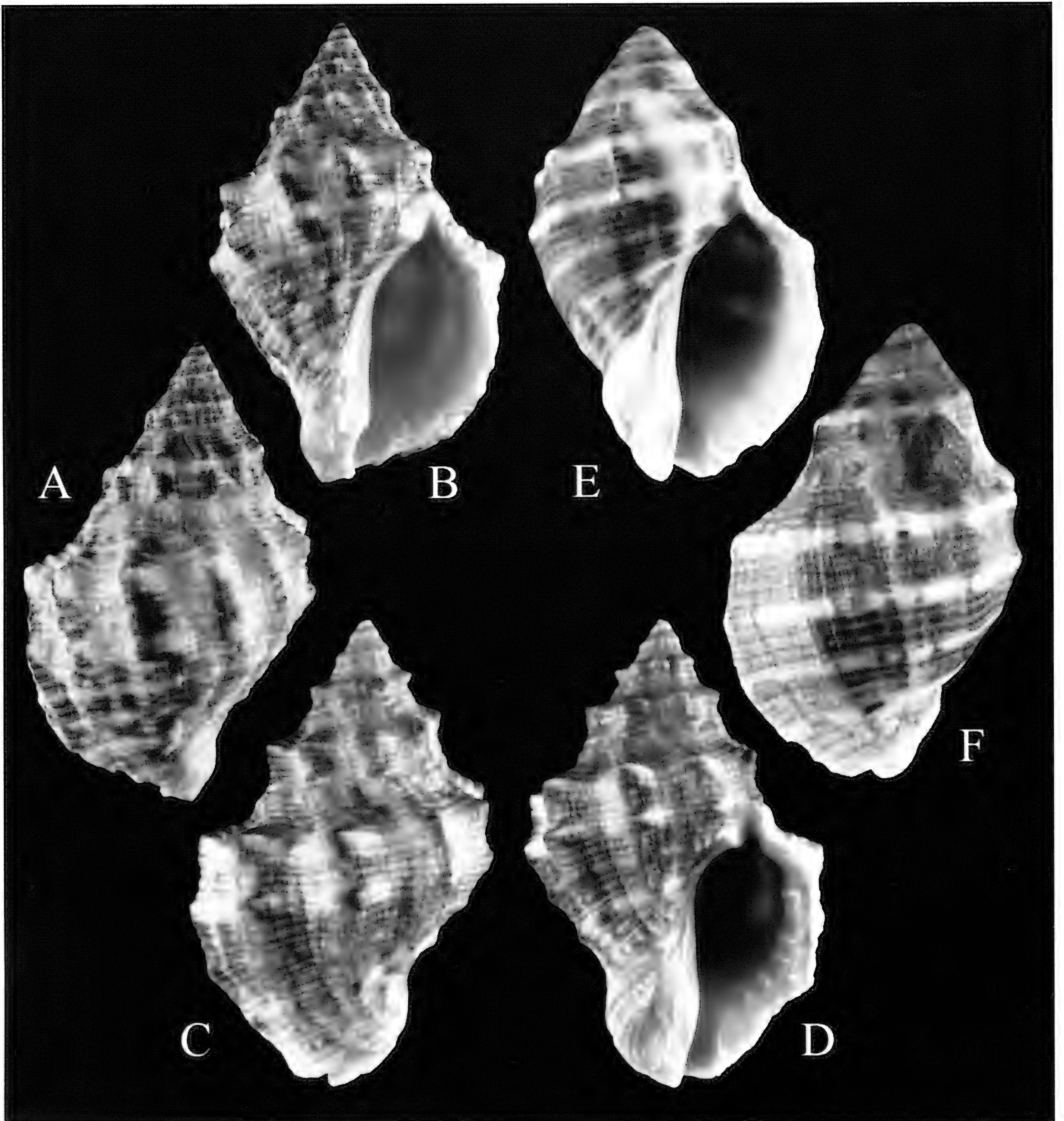
We thank the following for their generous donations of research specimens and also for their valuable information on the ecology and biogeography of the new taxa: Marcus Coltro and Jose Coltro (for the paratype of *Charonia marylenae*); Kevan and Linda Sunderland (for the type lot of *Prunum sunderlandorum*), James Ernest and the late Leonard Hill (for the type lot

of *Turritella (Torcula) howardpetersi*); and Darwin Alder (for *Stramonita alderi*).

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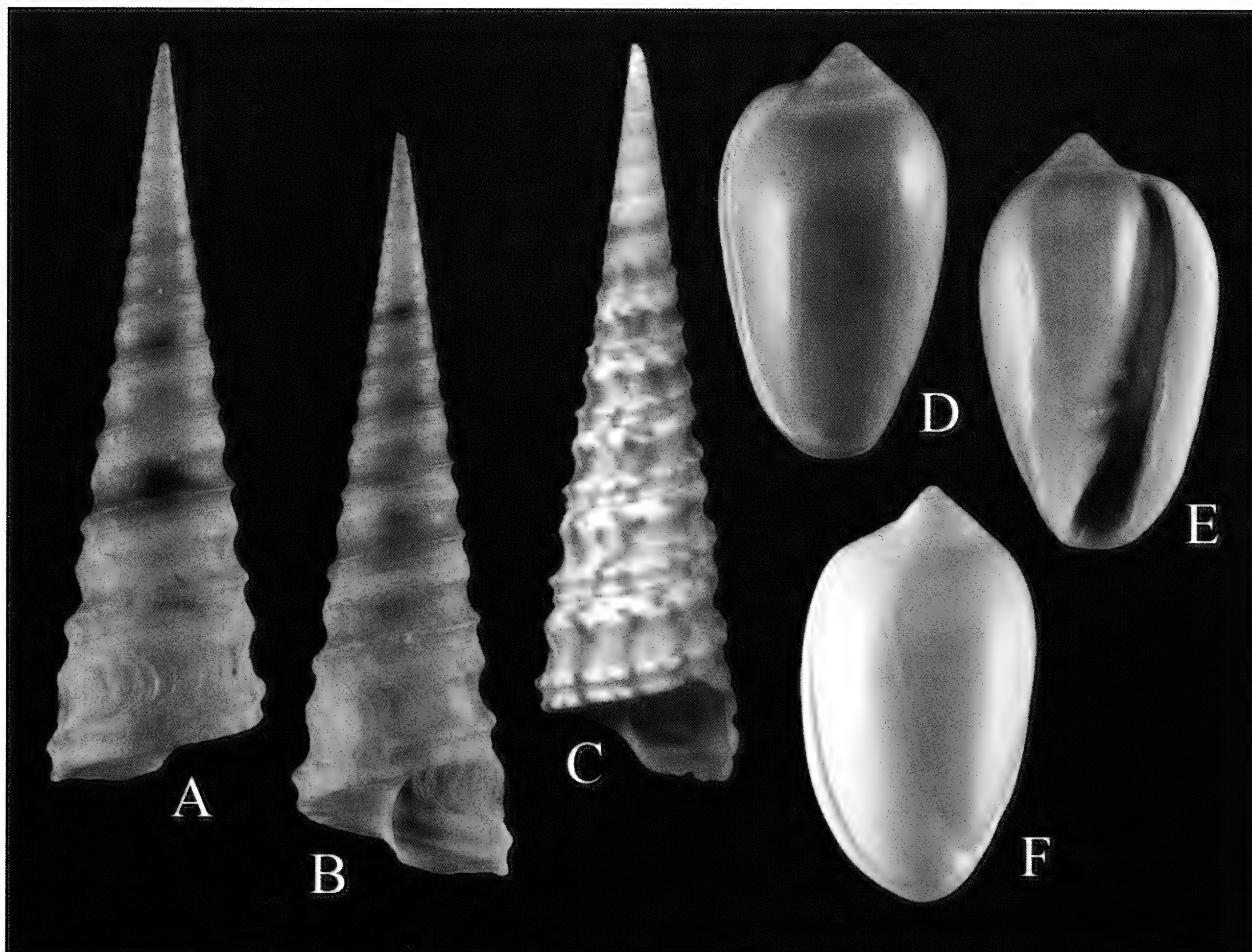




**Figure 1. *Stramonita* Species (Muricidae) from the Carolinian and Caribbean Provinces.**

**A, B= *Stramonita alderi* Petuch and Berschauer n. sp.**, holotype (LACM 3800), length 33.8 mm, collected dead on Fish Pass Jetty, Mustang Island, Corpus Christi, Nueces County, Texas; **C, D= *Stramonita buchecki* Petuch, 2013**, length 26.3 mm, Singer Island, Lake Worth Lagoon, Palm Beach County, Florida; **E, F= *Stramonita rustica* (Lamarck, 1822)**, length 25.0 mm, Piñones, Puerto Rico.

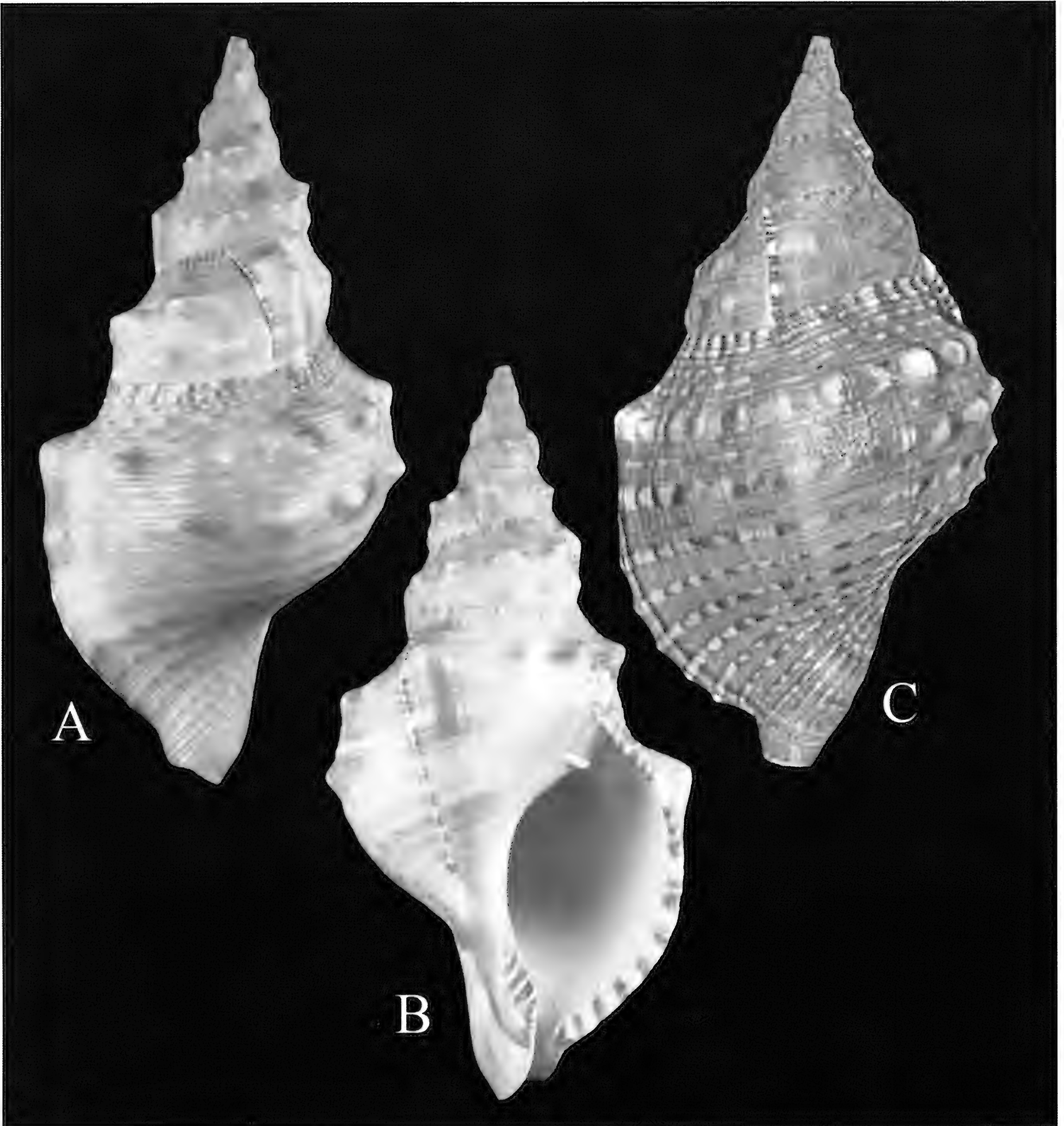




**Figure 2. *Turritella* (*Torcula*) Species (Turritellidae) and *Prunum* Species (Marginellidae) from the Nicaraguan Subprovince, Caribbean Province.**

**A, B**= *Turritella* (*Torcula*) *howardpetersi* Petuch and Berschauer, n. sp., holotype LACM 3801), length 37.5 mm, from 35 m depth off El Porvenir, San Blas Islands, Panama; **C**= *Turritella* (*Torcula*) *exoleta* (Linnaeus, 1758), length 62 mm, in coral rubble, 10 m depth off Green Turtle Cay, Abaco Islands, Bahamas; **D, E**= *Prunum sunderlandorum* Petuch and Berschauer, n. sp., holotype (LACM 3802), length 12.6 mm, 5 m depth in muddy sand in Trujillo Bay, Trujillo, Honduras; **F**= *Prunum leonardhilli* Petuch, 1990, length 21.0 mm, from 20 m depth off Portobello, Panama. Although the two *Prunum* species differ greatly in size, they are shown here as approximately the same size in order to allow for an easier comparison of their shell characters.





**Figure 3. *Charonia* Species (Charoniidae) from Brazil and South Africa.**

A, B= *Charonia marylenae* Petuch and Berschauer, n. sp., holotype (MZSP 150892), length 119.6 mm, 50 m depth off Cabo Frio, Rio de Janeiro State, Brazil; C= *Charonia pustulata* (Euthyme, 1889), length 185 mm, 10 m depth off Betty's Bay, Cape Province, South Africa.



## Comments on “Vandalism” in Malacology

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## INTRODUCTION

Malacology, as any science, progresses thanks to the comments and constructive criticism of other scientists. Comments help us to see other people's points of view, improve the scientific papers, and widen their importance. Constructive criticism and well thought out comments by Páll-Gergely expressed in his recent article (2020), as well as by any other malacologist or collector, are always welcome, where such criticism is communicated in a professional manner with the exclusive intention of improving the field of science. We understand that any arguments and criticism should provide an adequate scientific basis, accompanied by convincing proofs and avoiding personal attacks, insults, and the use of offensive words like “vandalism”. These provide the basic courtesies and support the foundation of science, and in malacology, as there are many more things in nature waiting to be discovered or better defined, *i.e.*, reviewed. Under this philosophy, we analyze and respond to the recent criticism and arguments of Páll-Gergely *et al.* (2020), in order to compare our viewpoints, and to show that we are strongly convinced of the validity of several previously described taxa by thoroughly reviewing the morphological characters that led us to those conclusions.

There can be doubts on the validity of any species hypothesis, and it is not rare to later conclude that some previously described species are only a variation that can be inferred from future examination of multiple specimens of a wide-ranging population. However, it is scientifically valid to maintain any morpho-species as an official taxon until a future more thorough study can be performed. The description of species is and has been widely subjective, and irrefutable proof, even from a molecular approach, does not exist.

## ABBREVIATIONS

NHMUK	Natural History Museum, London, England, UK
RMNH	Naturalis Center of Biodiversity, Leiden, The Netherlands
ZMMU	Zoological Museum of Moscow University, Russia

## DISCUSSION

Following we present some of our main arguments and supporting evidence why we are strongly convinced of the actual validity of some previously described taxa which have been challenged by Páll-Gergely *et al.* (2020), focusing primarily on *Amphidromus* species:



1. *Amphidromus cruentatus*, *A. daoae*, *A. daoae robertabbasi* do not have a reddish-brown aperture as argued (Páll-Gergely *et al.*, 2020, at p. 52). In fact, these species have a white aperture.

2. *Hempilecta pluto* has been interpreted as being highly variable in terms of basic shell morphology (Páll-Gergely *et al.*, 2020), an affirmative statement attributed to Inkhavilay *et al.* (2019), however, that paper does not support Páll-Gergely *et al.*'s statements of fact on any point.

3. *Amphidromus naggsi* (Figure 6, left) has been interpreted as being smoother than *A. ingens* (see Figure 6, right) (Páll-Gergely *et al.*, 2020, at p. 53), however the images clearly show *A. naggsi* has a more deformed shape, *i.e.* is less smooth than *A. ingens*.

4. There is an unjustified and unsupported accusation that the paper's the senior author has used other people's photos, *e.g.*, Bagni Liggia and Wikipedia (Páll-Gergely *et al.*, 2020, at p. 36). However, no specific figure(s) are referenced by Páll-Gergely as an example, and despite this unsupported allegation we see no problem in using other people's photos with their permission.

5. Many of the critical statements and conclusions of Páll-Gergely *et al.* (2020) were internally inconsistent, doubtful or unsupported, for example:

A. *Amphidromus thanhhoaensis* "is valid" (Páll-Gergely *et al.* (2020), at pg. 67) and only "apparently valid" (pg. 55);

B. *Cyclotus huberi* is "a valid species" on MolluscaBase since September 22, 2018 but "this species could be valid" (Páll-Gergely *et al.* (2020), at pg. 38);

C. *Cyathopoma huberi* has been accepted as valid on MolluscaBase since September 21, 2018, but it is "apparently invalid" (Páll-Gergely *et al.* (2020), at pg. 73, as "no comments").

6. Páll-Gergely did not contact the senior author before renaming taxa. The act of renaming *Amphidromus severnsi anhi* and *Satsuma huberi* breached the rules set forth in Appendix No. 3 of Code of Ethics in the 1999 ICZN, by not contacting the author beforehand to discuss the proposed changes.

7. There is a bold and unsupported assertion by Páll-Gergely *et al.* (2020, in the article's abstract) that all newly described species were "described in non-peer-reviewed journals." (It should be noted that the ICZN does not require peer review for a taxa to be valid.) However, the disputed taxa were published in the following journals which are peer-reviewed: Basteria, of the Netherlands (*Amphidromus naggsi*, *Acesta kronenbergi*); Conchylia, of Germany (*Amphidromus christabaerae*, *A. huynhanhi*, *A. keppensdhondtorum*, *A. renkeri*); Gloria Maris, magazine of Belgium (*Amphidromus huberi*, *A. setzeri*, *Camaena onae*, *Cyclophorus stevenabbasorum*); Malacologia Mostra Mondiale, of Italy (*Vasticardium kuboderai*); Miscellanea Malacologica, of The Netherlands (*Solen moolenbeeki*, *Anadara dekkeri*); Novapex, of Belgium (*Pterocyclos huberi*, *Lanceolaria bogani*); The Festivus, of USA (*Bertia setzeri*, *Camaena abbasi*, *C. chuongi*, *Vasticardium berschaueri*, *Vepricardium eichhorsti*), Visaya (*Amphidromus ngai*, *A. sowyani*, *Solen poppei*); Xenophora Taxonomy, of France (*Fulgoraria alforum*, *F. bailorum*, *F. callomoni*), *etc.* This assertion by Páll-Gergely *et al.* is not only incorrect but it is potentially defamatory to both the senior author and each of these highly esteemed and peer reviewed journals.



8. The following species were considered by Páll-Gergely *et al.* 2020, to be simply color variants, however they furthermore differ in many other characters such as shell shape, columella shape, outer lip shape, *etc.* Set forth below are some typical examples, although other examples will be presented in a future paper.

- *Amphidromus baerorum* Thach, 2018 (Figure 1a) is significantly different from *A. smithii* Fulton, 1896 (Figure 1b) based on the following characters: (1) broader, twisted and not black columella; (2) wider aperture; (3) more inflated body whorl; (4) presence of orange spiral bands along sutures; (5) white (not black) outer lip; (6) presence of a white spiral band at mid-body whorl; and (7) green (not yellow) body whorl. There are seven character differences, but Páll-Gergely *et al.* (2020) apparently either could not detect them, or ignored them, and consider the former as a color variant of the latter. The appearance of columella is a major difference in shell sculpture, it is not a color variant, not a minor shell character, and is too important a character not to be used to distinguish or separate species. It is common knowledge even among collectors and dealers that they are not conspecific.

- *Amphidromus davidmonsecoruri* Thach, 2018 (Figure 2a) is significantly different from *A. smithii* Fulton, 1896 (Figure 2b) based on the six following characters: (1) white (not black) and not straight columella; (2) much wider aperture; (3) more inflated body whorl; (4) more constricted sutures; (5) red early whorls; and (6) purplish (not black) outer lip. The difference of the columella is a major difference in shell sculpture, it is not a color variant, and not a minor shell character. One should not engage in sophistry to consider this species as a synonym without proof of similarity. Any character in new species that Páll-Gergely described was

considered by him to be a major character, while characters used in new species described by other authors were considered by him to be minor characters. This argument is intellectually inconsistent and reflects poorly on Páll-Gergely *et al.* as it shows that they were not impartial in their analysis and comments.

- *Amphidromus fraussenae* Thach & Huber, 2017 (Figure 3a) significantly differs from *A. ventrosulus* Möllendorff, 1900 (Figure 3b) based on seven important characters: (1) columella broader, purple red (not pink) and directed leftward (not rightward); (2) outer lip thicker, more solid and extending far at posterior end before touching the remaining shell; (3) spire narrower, more slender and straight-sided; (4) lacking green subsutural bands; (5) aperture more elongate; (6) parietal wall wider, not yellow and more calloused; and (7) lacking axial stripes at body whorl. It is clearly visible that these two shells are not identical. We do not agree that the former is a synonym of the latter. These seven main differences are sufficient to separate them into two different species. Considering *A. fraussenae* as synonym is inappropriate. As Páll-Gergely *et al.* (2020) considered both *A. fraussenae* and *A. cargilei* as synonyms of *A. ventrosulus*, the shells must look alike. However, the individual shells shown in Figures 3a and 4a do not show any significant similarity between them.

- *Amphidromus cargilei* Thach & Huber, 2018 (Figure 4a) significantly differs mainly from *A. ventrosulus* Möllendorff, 1900 (Figure 4b) based on many important characters: (1) columella white (not pink), flared inward and directed leftward (not rightward); (2) outer lip thinner and flared outward; (3) sutures more constricted; (4) sutural bands not green; (5) aperture more elongate; (6) parietal wall well defined and black (not yellow); (7) lacking axial stripes at body whorl; and (8) body whorl more



inflated. It is clearly visible that these two shells are not identical. We do not agree that the former is a synonym of the latter. These eight main differences are sufficient to separate them into two different species. While Pall-Gergely *et al.* maintain that *A. cargilei* is a synonym of *A. ventrosulus*, they have not shown any proof of similarity on photos of these two shells.

- ***Amphidromus daoae*** Thach, 2016 (Figure 5a) is significantly different from *Amphidromus cruentatus* Morlet, 1875 (Figure 5b) based on the following characters: (1) inflated (not flat), narrower, black (not brown) columella; (2) more inflated body whorl; (3) more pointed and straight-sided spire; (4) not constricted sutures; (5) larger and greenish (not white) aperture; (6) black (not brown) outer lip with white (not black) inner margin; and (7) presence of axial stripes, especially at spire whorls. There are seven significant character differences between the two species however Páll-Gergely *et al.* (2010) engaged in sophistry to consider the former as a synonym of the latter. The conclusions by Páll-Gergely *et al.* are problematic as they are inconsistent with the available evidence, such as stating that the aperture of *A. cruentatus* is red-brown, and ignoring the difference in the columella which represents a major difference in shell character.

- ***Amphidromus naggsi*** Thach & Huber, 2014 (Figure 6a) is significantly different from *A. ingens* Möllendorff, 1900 (Figure 6b) based on the following characters: (1) rugose (not smooth) outer surface; (2) more numerous spiral grooves at body whorl (2-3 grooves versus one groove); (3) stronger sculpture; (4) wider aperture; and (5) posterior canal not pointed. These five character differences support the assertion that they are two different species. However, Páll-Gergely *et al.* engaged in sophistry to consider *A. naggsi* a synonym of *A. ingens*.

- ***Amphidromus petuchi*** Thach, 2018 (Figure 7) is significantly different from *A. reflexilabris* Schepman, 1892 (Figure 8) based on the following characters: (1) outer lip turned backward at anterior end, not rolled into a rounded tube at dorsal side and not pink; (2) angulate (not rounded) aperture; (3) taller spire; (4) slender shape; (5) presence of many spiral bands; (6) not curved and white (not pink) columella; and (7) adherent periostracum with brown stripes (not easily worn periostracum with green stripes). There are seven major character differences. However, Páll-Gergely *et al.* (2020) said there is only a difference of color (a mere color variant). The differences in characters (1) outer lip, (2) aperture, (4) shell shape, and (6) columella, are major differences in shell character, not mere variation of color. It is even common knowledge among collectors and dealers that these are two different species.

- ***Amphidromus calvinabbasi*** Thach, 2017 (Figure 9) is significantly different from *Amphidromus reflexilabris* Schepman, 1892 (Figure 8) based on the following characters: (1) not pink outer lip that is not rolled into a rounded tube at dorsal side; (2) sharply angulate (not rounded) aperture; (3) tall spire; (4) slender shape; (5) presence of many spiral bands; and (6) straight (not curved) and white (not pink) columella. There are six above-mentioned significant character differences. However, Pall-Gergely *et al.* (2020) engaged in sophistry to consider the former as a color variant of the latter. The differences in characters (1) of outer lip, (2) of aperture, and (6) of the columella are major character differences in shell sculpture, not a mere color variant.

- ***Amphidromus juniorabbasi*** Thach, 2018 (Figure 10) is significantly different from *Amphidromus reflexilabris* Schepman, 1892 (Figure 8) based on the following characters: (1) white outer lip that is not pink and not rolled



into a rounded tube at dorsal side; (2) angulate (less rounded) aperture; (3) tall spire; (4) slender shape; (5) presence of axial lines at body whorl; and (6) straight (not curved) and white (not pink) columella. There are six above-mentioned character differences, however Páll-Gergely *et al.* (2020) considered the former as color variant of the latter. The differences in characters (1) of outer lip, (2) of aperture, and (6) of columella are major character differences in shell sculpture, not a mere color variant.

• *Amphidromus richgoldbergi* Thach & Huber, 2017 (Figure 11) is significantly different from *A. "givenchyi"* of Sutcharit & Panha, 2006" (Figure 12) based on many characters such as: (1) much larger adult size; (2) much higher than wide (not stout shape); (3) pointed and more straight-sided spire; (4) not constricted sutures; (5) red (not brownish spot) on apex; (6) taller body whorl; (7) broader and longer columella; (8) presence of green varix; (9) more elongate aperture; (10) parietal wall with red blotch, not white like their *A. "givenchyi"* of Sutcharit & Panha, 2006" and well defined and bordered by green wavy line; (11) outer lip solid at dorsal side while that of their *A. "givenchyi"* is hollow and well visible in Figure 12; (12) posterior margin of outer lip not strongly convex and not steeply ascending; (13) straight (not curved) and longer columella; (14) deep yellow-orange at outer surface (not almost greenish like their *A. "givenchyi"*); and (15) umbilicus is closed in *A. richgoldbergi* and open in their *A. "givenchyi"*. These numerous differences support the species hypothesis that *A. richgoldbergi* is a separate species as it is significantly different from *A. "givenchyi"*. It is even common knowledge among collectors and dealers that they are two different species.

Many of the characters noted in the paragraphs above demonstrate why these species were

designated new species when originally described. It is understandable that some of these characters may have eluded or been undetected by Páll-Gergely *et al.*, as they are not experts in *Amphidromus* identification. However, personal attacks are unacceptable in science, and it was also inappropriate for Páll-Gergely *et al.* to ignore or intentionally overlook unique identifying shell characters in order to arrive at their desired conclusions, or due to what appears to be professional jealousy.

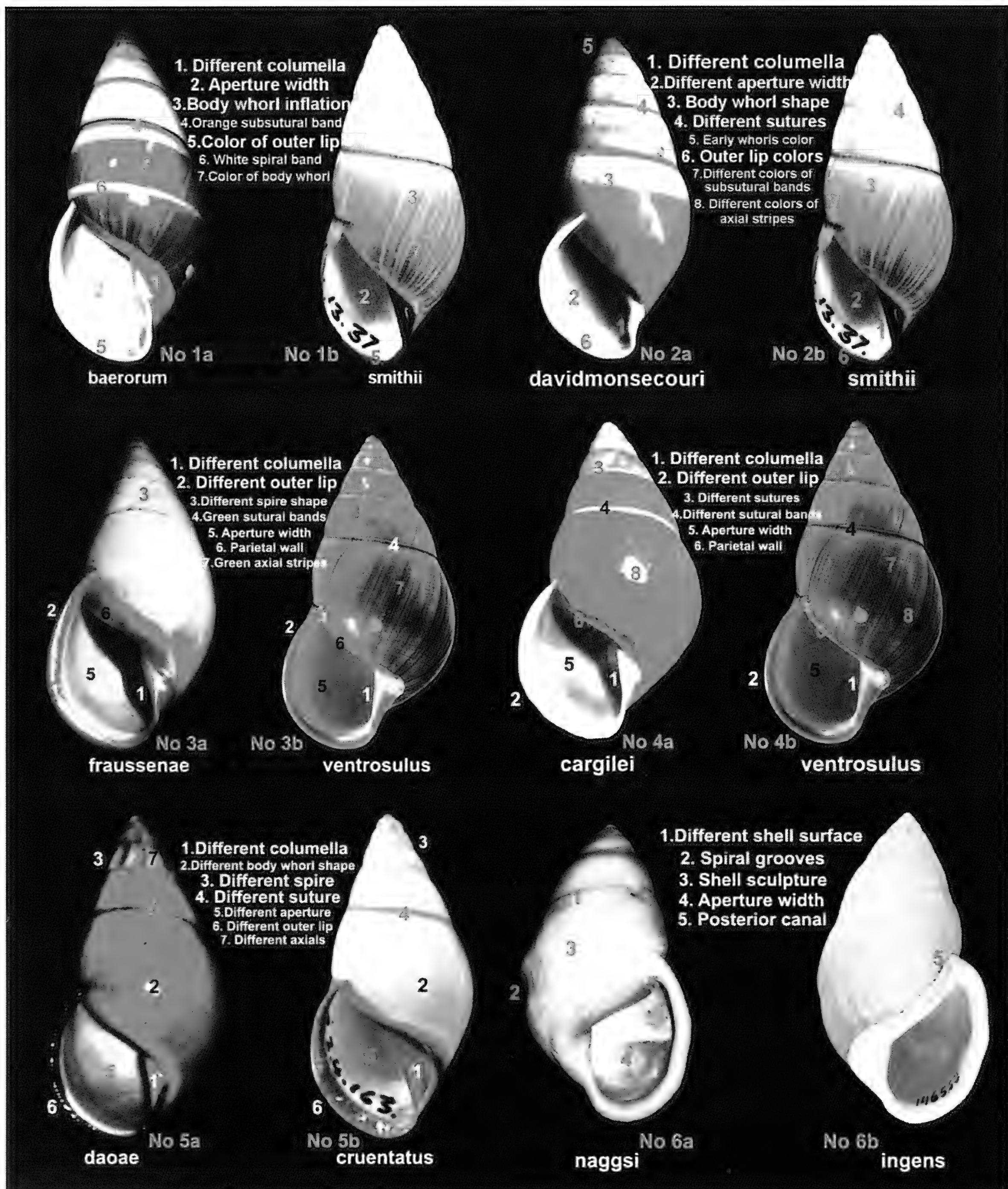
## ACKNOWLEDGEMENTS

The author sincerely thanks the London National Museum of Natural History, the Leiden Naturalis Center of Biodiversity, the Zoological Museum of Moscow University and Andy Tan for the use of their photos of various *Amphidromus* species. Thanks are also due to the anonymous reviewers.

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**Plate 1. Diagnostic differences between species.**

1a,1b. Difference between *Amphidromus baerorum* and *Amphidromus smithii*, photo of NHMUK.

2a,2b. Difference between *Amphidromus davidmonsecouri* and *Amphidromus smithii*, photo of NHMUK.

3a,3b. Difference between *Amphidromus frussenae* and *Amphidromus ventrosulus*, photo of NHMUK.

4a,4b. Difference between *Amphidromus cargilei* and *Amphidromus ventrosulus*, photo of NHMUK.

5a,5b. Difference between *Amphidromus daoae* and *Amphidromus cruentatus*, photo of NHMUK.

6a,6b. Difference between *Amphidromus naggsi* and *Amphidromus ingens*, photo of ZMMU.



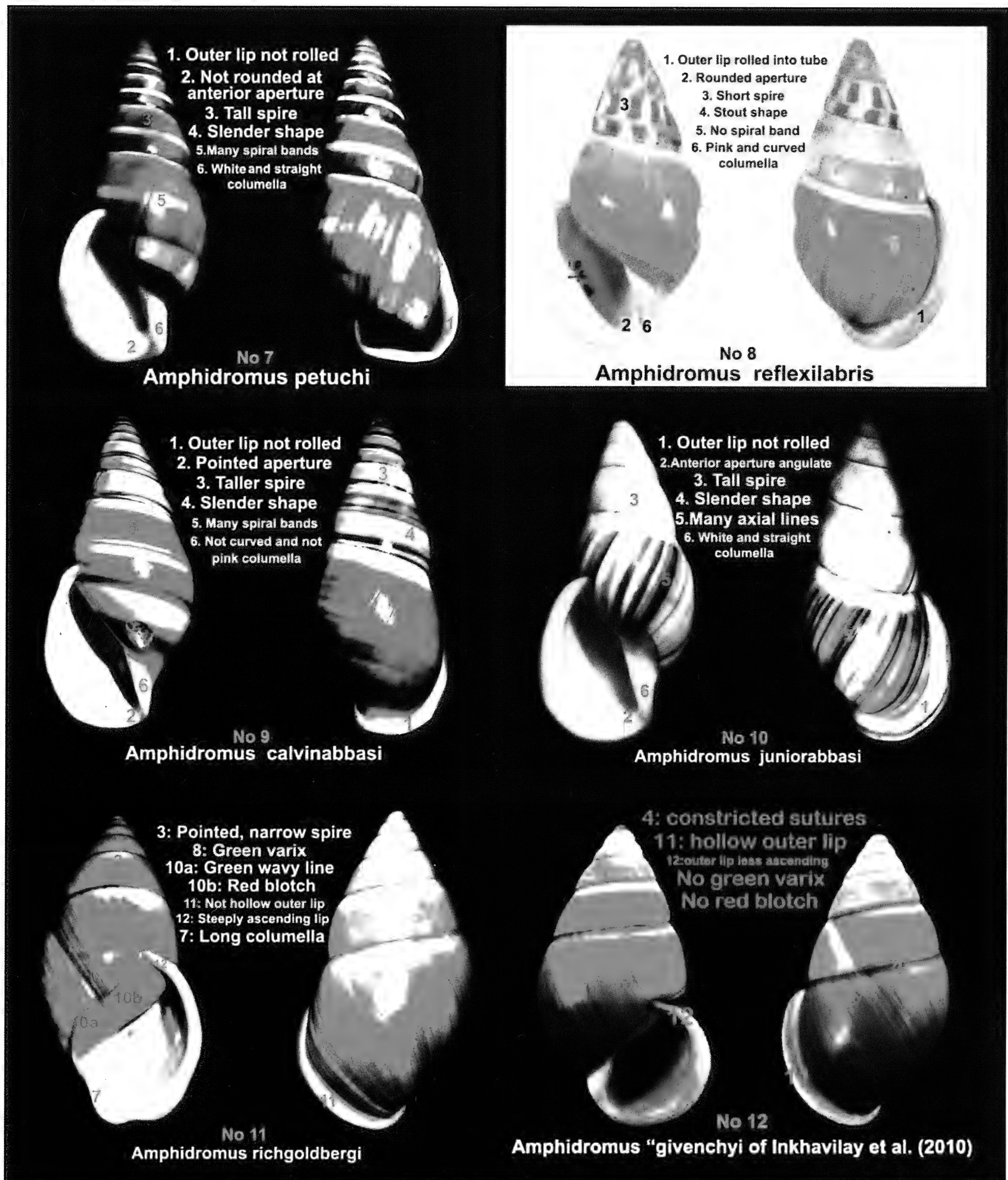


Plate 2. Diagnostic differences between species.

7. *Amphidromus petuchi* ; 8. *Amphidromus reflexilabris* for comparison, photo of RMNH; 9. *Amphidromus calvinabbasi*; 10. *Amphidromus juniorabbasi*; 11. *Amphidromus richgoldbergi*; 12. *Amphidromus "givenchy" of Sutcharit & Panha, 2016* for comparison, photo of Andy Tan.





### **Have a shell collection you would like to donate to The San Diego Shell Club?**

The San Diego Shell Club is interested in your shell collection. As a 501c(3) organization, all donations to our Club may provide a tax write-off. When we receive a donation we provide a letter describing the items that may be used when filing your taxes.

While we cannot provide a value, donations of up to \$5,000 do not require a written appraisal. Since tax laws change regularly we recommend that you check with your tax accountant before relying on any information provided here.

We are interested in all types of shells, marine or land and all genera and species, including books on shells as well as items related to shells such as artwork, storage cases and tools. Your donated items will be used to generate income to support the Club's efforts in continuing Public education about shells and conservation of marine life throughout the world. If you would like to donate, please contact David Waller, SDSC Acquisition Chairperson, at [dwaller@dbwipmg.com](mailto:dwaller@dbwipmg.com) to schedule a time to discuss charitable gifting.

## **CLUB NEWS**

### **2020 February General Meeting**

Our February general meeting was held at Leo Kempczenski's home in Tustin. We had an incredible turn out with members from three counties (and out of State) present. Roger Clark gave the presentation on how to collect and preserve chitons.

### **2020 March General Meeting**

Canceled due to the COVID19 pandemic.

### **2020 Spring Auction and Potluck**

Canceled due to the COVID19 pandemic.



## Editor's Corner - What "peer reviewed" means and does not mean

David P. Berschauer, Editor  
[shellcollection@hotmail.com](mailto:shellcollection@hotmail.com)

Our journal has been a peer reviewed journal for many decades. Carole Hertz, as editor in the 1970s, made changes to the format and content of the Festivus transforming it into a scientific peer reviewed journal. Over the past seven years since the changing of the "editorial guard" we have heard comments made by people who do not seem to understand just what "peer reviewed" means. Some people have voiced arm chair opinions which show that they believe that there is, or should be, some kind of "scientific clearing house" by a panel of appointed "experts", or a democratic voting process that taxonomic hypotheses in scientific papers are subjected to.

What "peer reviewed" actually means is that the editors send the author's article to one or more other scientists who work in the same field (or a similar field) to evaluate the quality of the research and its suitability for publication. Peer review requires critical reading, analysis, and providing feedback. Acceptance for publication following peer review also requires adherence to the editorial standards of the journal. Most journals publish a detailed list of requirements for authors to review before submitting an article describing their scholarly work. The fact that an article has been vetted by a peer review process does not necessarily mean that other scientists in the same field agree with the author's hypotheses, analysis or conclusions - merely that it meets certain scientific standards and is therefore suitable for publication. There is no scientific "voting process" involved, and subjecting science to such a pseudo-democratic process would impede scientific inquiry and progress as only articles which support the dominant paradigm would ever be published.

The International Code of Zoological Nomenclature sets forth the rules governing taxonomic acts. There is nothing in the ICZN code allowing for or requiring some kind of panel of "experts" to approve a new taxon. The requirements of the Code in this regard are fairly simple and include a description, publication, and a designated type. (see §8.1 governing publication, §13.1 governing species names after 1930 - merely requiring that a new species name "be accompanied by a description or definition that states in words characters that are purported to differentiate the taxon", and §72.3 a holotype or syntypes must be designated as they "are the international standards of reference that provide objectivity in zoological nomenclature and must be cared for as such ... and are to be held in trust for science by the persons responsible for their safe keeping.") Every new species name (or other taxon) is a hypothesis, one which is based upon all of the evidence then available to the authors when their article is published. Contrary to popular opinion the website WoRMS (World Registry of Marine Species) is not a taxonomic "clearing house" and has no authority under the ICZN or otherwise to "declare" species valid or not. There is and can be no "taxonomy by decree" by a group or an individual. Any serious effort to perform a taxonomic act (such as synonymizing two or more taxa) requires at a bare minimum the same degree of scientific effort and diligence as the original authors put forth, followed by the peer review process and publication. When scientists disagree about a taxonomic act they are encouraged to do their own independent research and publish an appropriate rebuttal paper with their hypotheses, the results of their research, and their conclusions.



## *Zoila eludens eludens* vs. *Z. eludens delicatura*

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For this column, I review some of the information that I was able to obtain distinguishing *Zoila eludens eludens* Raybaudi, 1991 from *Zoila eludens delicatura* Chandler & Du Ross, 1997, two species that look very similar but whose values can differ by several hundred dollars. MolluscaBase ([www.molluscabase.org](http://www.molluscabase.org)) lists three *Zoila eludens* subspecies: *Z. e. eludens* Raybaudi, 1991; *Z. e. delicatura* Chandler & Du Ross, 1997; and *Z. e. stricklandi* Lorenz, 2015. *Zoila eludens stricklandi* is distinguishable from *Z. e. eludens* and *Z. e. delicatura* by its size, base color, lack of marginal callusing, and minimal or lack of basal spotting. More specifically, the average size of *Z. e. stricklandi* is about 38-43 mm (Lorenz, 2017), the base color is generally orange to orange-brown with minimal marginal spotting extending onto the base and a lack of marginal callus flanges. However, differentiating *Z. e. eludens* from *Z. e. delicatura* is more difficult because these subspecies have similar shape, color and dorsal markings.

*Z. eludens eludens* Raybaudi, 1991 (La Conchiglia 260:8-15) “**Colour and Pattern:** dorsum ivory coloured, strongly spotted with brown to blackish brown. Dark tips. Height of the margins: 20-22 mm, ivory coloured with less numerous but more dark and strong spots. Basis distinctively orange coloured, sometimes clouded. **Size and Shape:** average length 60 mm; height 39 mm. A very humpbacked cowrie, extremely solid and heavy: holotype weight is 46 gr. (twice the weight of *decipiens*). **Aperture:** near straight and quite narrow. Fossula not much deep and toothless. 18 columellar short teeth, 21 labial teeth; they continue in the colour up to the margin. **Spire:** absent, barely perceptible in some paratypes.”

“Very heavy, solid. Dorsum humped. Base slightly convex, callused. Margins rounded, sometimes very callused. Teeth rounded and short, well produced throughout both sides. Base cream, blotched with dark orange to brown. Margins cream, coarsely spotted, distinctly iridescent, often with a bluish dorsal frame. Dorsum densely mottled with brown and black. Black terminal spots.” Location was reported as “Exmouth area, Western Australia” found at depths of “28 to 45 m” with a size range of “43 to 74 mm” (F. Lorenz, Monograph of the Living *Zoila*, 2001).

“Shell broadly ovate to subpyriform, solid, heavy; base flat; dorsum high humped with steep posterior slope; spire slightly protruding but covered with callus, body whirl suture impressed; right margin rounded centrally, left margin subangulate, slightly flanged anteriorly, ends slightly projecting, sides of channels not elevated; aperture almost straight, weakly dilated anteriorly; labial teeth strong, deep vertically but not extending across outer lip, numbering 18-21; columellar teeth weaker than labials but nevertheless moderately strong, even-sized and extending along entire length of inner lip. Dorsum ivory, overlain to the point of being almost obscured by merging dark chocolate-brown spots and maculations, indistinct mantle line sometimes present; ends brown, sides orange at margin, becoming granulose and clouded bluish-grey dorsally, with prominent, large dark



brown spots; base orange to cream or off-white, teeth darker orange; fossula white.” (B. Wilson and P. Clarkson, Australia’s Spectacular Cowries, 2004).

“Large rather heavy. Rounded extremities. Densely spotted dorsum. Margins rounded, sometimes forming callous flanges. Sides cream with darker spotting and a greyish-blue “halo” framing the dorsum. Base cream to orange, often with darker blotches. Spire covered with callus” with a size range of “43 to 74 mm” (F. Lorenz, Cowries, A Guide to the Gastropod Family Cypraeidae, 2017).

***Z. eludens delicatura*** Chandler and Du Ross, 1997 (World Shells 20:65-67) Holotype description: “Length, 47mm. Width 32mm. Height, 26.5mm. Weight 14gr. Teeth: Columellar 10. Labial 18. Shape: Very similar to *perlaea* (*Zoila*) Dorsum: Heavy brown blotching smudged over ivory. Extremities: dark brown. Spire: The apex is well visible. Margins: brown spots on ivory base. Base: Brown centre shading to ivory. Fossula: Brown spots on ivory base. Inside: Dark ivory. HABITAT: Found on rocky bottom on sponges 64mts. to 90mts. DISTRIBUTION: N.W. Australia off the N.W. Shelf in the vicinity of the Monte Bello Islands NAME MEANS: Daintiness. Refinement. Delicacy.” Table 1 reports that the length of the specimens collected is from “43 mm to 55 mm” that the number of columellar teeth ranges from “3 to 16” and the number of labial teeth ranges from “18 to 20”.

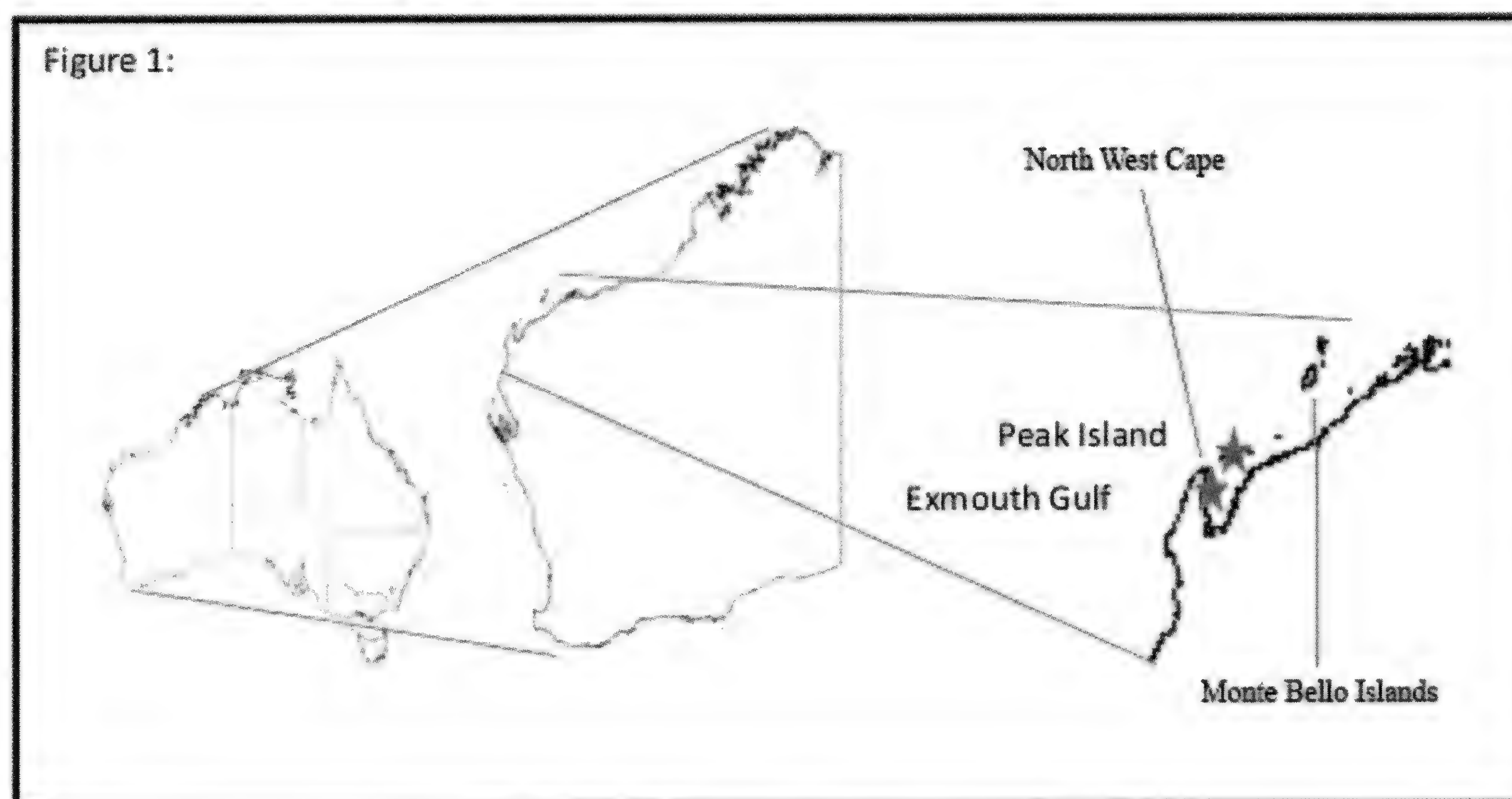


Figure 1: Locations of area range where *Z. e. eludens* and *Z. e. delicatura* are found.

“Smaller and less callused, usually more elongate shells. Margins less callused and less densely spotted” found in the “Northern limit of the distribution” at depths of “35 to 70 m”. The size range of specimens shown in Plate 3 is from 50 to 56 mm (F. Lorenz, Monograph of the Living Zoila, 2001).

“Shell stoutly pyriform, humped, with inflated, convex sides; spire exsert, moderately callused in adults either aligned with center of posterior canal or offset to left; canals rounded and not greatly elevated; anterior canal slightly pinched above. Labial teeth weak, numbering 17-21; columellar teeth weak, usually confined to anterior end, numbering only 3 to 8 but sometimes with faint denticles



along entire columellar side in which total number may be as high as 18. Colour variable, usually pale brown with darker, confluent dorsal spots, lateral spots prominent to diffuse or even absent, conspicuous terminal blotches bordering anterior and posterior canals, sides with a conspicuous or vague smoky zone below and surrounding dorsum; base pale orange to buff.” (B. Wilson and P. Clarkson, Australia’s Spectacular Cowries, 2004).

“Smaller and less calloused, narrower. Posterior extremity more rostrate. Margins less expanded. Columellar teeth indistinct to absent posteriorly. Interior of the shell purple. Base with dark stripes”. The size range is “43-53 mm” and location is “Peak Island”. (F. Lorenz, Cowries, A Guide to the Gastropod Family Cypraeidae, 2017).

Subspecies	<i>Z. e. eludens</i>	<i>Z. e. delicatura</i>	Comments
<b>Described</b>	L. Raybaudi, La Conchiglia 260:8-15, 1991	J. Chandler and C. Du Ross, World Shells 20:65-67, 1997	
<b>Size</b>	43 to 74 mm* 42 to 74 mm**	43 to 53 mm* 45 to 53 mm**	<i>Z. e. delicatura</i> size range falls within that for <i>Z. e. eludens</i> .
<b>Weight</b>	Very heavy * Solid, heavy**	No reference was made to weight in comparison to other species.	Relative
<b>Shape</b>	Dorsum humped.* Broadly ovate to sub-pyriform.**	More elongate.* Stoutly pyriform, humped with inflated convex sides.**	<i>Z. e. delicatura</i> is more elongate in shape than <i>Z. e. eludens</i> .
<b>Dorsum Coloration</b>	densely mottled with brown and black.* Ivory, overlain to the point of being almost obscured by merging dark chocolate-brown spots and maculations, indistinct mantle line sometimes present.**	Usually pale brown with darker, confluent dorsal spots, lateral spots prominent to diffuse or absent.**	Pale brown dorsal markings of <i>Z. e. delicatura</i> can be similar to the brown dorsal markings of <i>Z. e. eludens</i> and can be difficult to compare when the dorsal spotting is perfunctory.
<b>Base Coloration</b>	Cream to orange, often with darker blotches.* Base orange to cream or off-white.**	Less callused with dark stripes. Base with dark stripes.* Base pale orange to buff.**	<i>Z. e. eludens</i> can be similar to <i>Z. e. delicatura</i> .
<b>Margin Coloration</b>	Margins cream, coarsely spotted, distinctly iridescent, often with a bluish dorsal frame.* Sides orange at margin,	Less callused and less densely spotted Margins less expanded.* Conspicuous or vague smoky zone below and	<i>Z. e. delicatura</i> can be less densely spotted along its margins compared to <i>Z. e. eludens</i> . The bluish dorsal frame of <i>Z. e. eludens</i> can sometimes be



	becoming granulose and clouded bluish-grey dorsally, with prominent, large dark brown spots.**	surrounding dorsum.**	observed in <i>Z. e. delicatura</i> .
Spire	Covered with callous.* Slightly protruding but covered with callus with body whirl suture impressed.**	Spire exsert, moderately callused either aligned with center of posterior canal or offset to left.**	<i>Z. e. delicatura</i> is more exsert than the spire of <i>Z. e. eludens</i> .
Termini	Right margin rounded centrally, left margin subangulate, slightly flanged anteriorly, ends slightly projecting, sides of channels not elevated.**	Posterior extremity more rostrate.* Canals rounded and not generally elevated; anterior canal slightly pinched above. Conspicuous terminal blotches bordering anterior and posterior canals.**	Similar for these two species.
Aperture	Almost straight.**	No reference was made to the aperture in comparison to other species.	Similar for these two species.
Teeth	Labial teeth strong, deep vertically but not extending across outer lip, numbering 18-21; columellar teeth weaker than labials but nevertheless moderately strong, even-sized and extending along entire length of inner lip.**	Columellar teeth indistinct to absent posteriorly.* Labial teeth weak, numbering 17-21; columellar teeth weak usually confined to anterior end, numbering only 3 to 8.**	Similar for these two species.
Interior	Interior of specimens in plate 1 (A-F) light violet-tan.	Interior of the shell purple. *	<i>Z. e. delicatura</i> is significantly darker in the specimens shown here.
Location	Exmouth area* North West Cape to Peak Island**	Peak Island*	

**Table 1.** Comparison of information on *Z. e. eludens* and *Z. e. delicatura*.

\* F. Lorenz, Cowries, A Guide to the Gastropod Family Cypraeidae, 2017

\*\* B. Wilson and P. Clarkson, Australia’s Spectacular Cowries, 2004



Characteristics distinguishing *Z. e. eludens* from *Z. e. delicatura* that may be helpful are shown in red (Table 2).

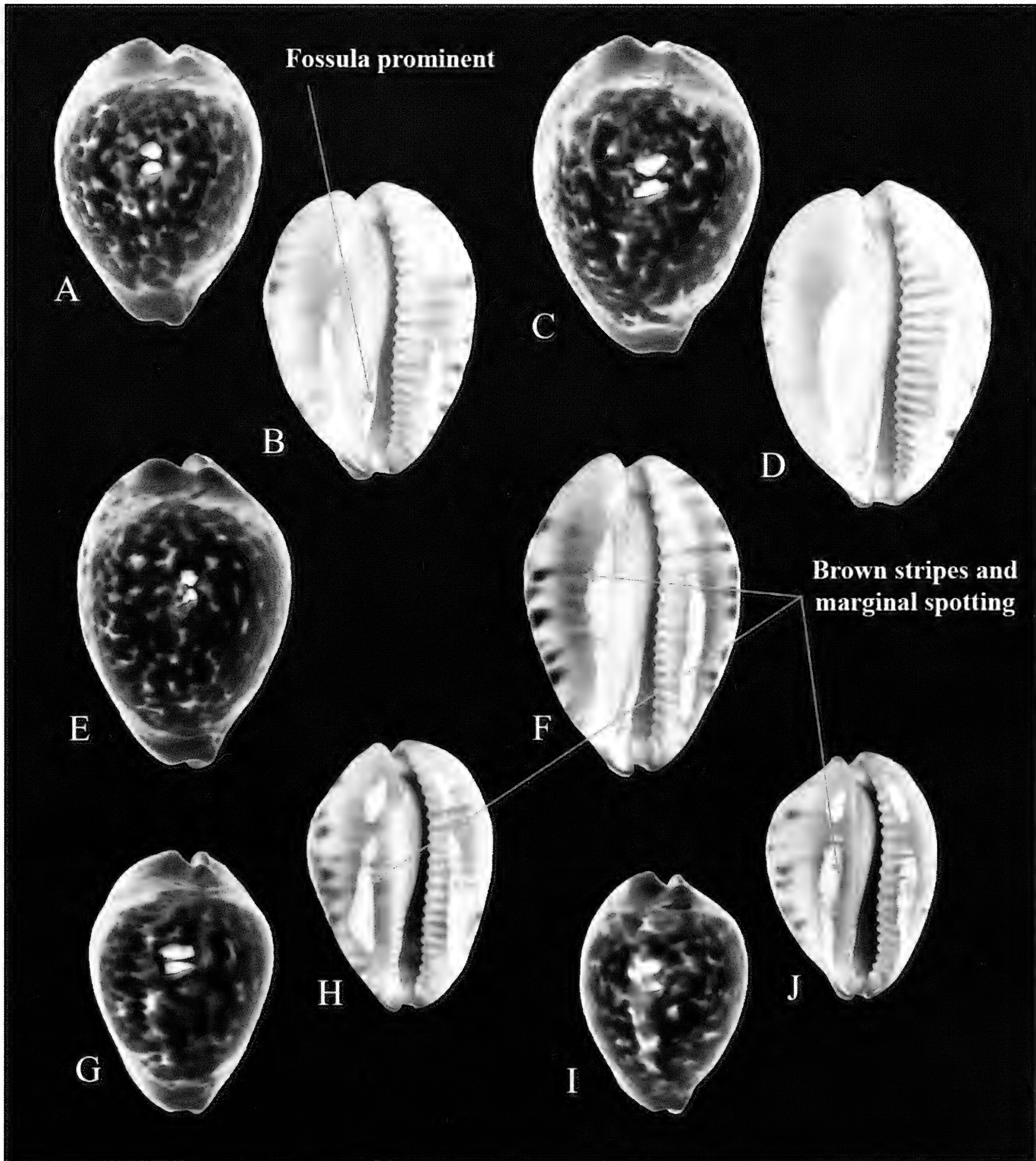
Subspecies	<i>Z. e. eludens</i>	<i>Z. e. delicatura</i>
Dorsum Coloration	Dorsal base coloration ivory, coarsely spotted to the point of being almost obscured by merging dark chocolate-brown spots, often with bluish dorsal frame.	Dorsal base coloration is pale orange to buff. Bluish dorsal frame not common.
Shape	Broadly ovate to sub-pyriform, dorsum humped.	Stoutly pyriform, elongate, dorsum humped.
Base Coloration	Base coloration is orange to cream or off-white, can be blotched with dark orange to brown.	Usually pale orange-brown with darker confluent dorsal spots on columellar side and lateral streaking on labral side extending from teeth.
Fossula	Fossula prominent.	Fossula less prominent.
Interior	Light violet-tan	Purple
Location	Exmouth area to Peak Island	Peak Island

Table 2. Distinguishing characteristics noted for *Z. e. eludens* and *Z. e. delicatura*.

Plates 1-3 show three specimens of *Z. e. eludens* and two specimens of *Z. e. delicatura*: A, B - *Z. e. eludens*, 56.0 mm, Exmouth, Northwest Australia diver taken at 25M; C, D - *Z. e. eludens*, 62.4 mm, South Murion Island, Exmouth, Northwest Australia diver taken at 30M; E, F - *Z. e. eludens*, 61.3 mm, diver taken at 32M; G, H - *Z. e. delicatura*, 51.7 mm west of Peak Island, Northwest Australia diver taken at 41M; and H, I - *Z. e. delicatura*, 47.1 mm, Peak Island, Northwest Australia trawled 40-50M ex. Bass Straights Shell Museum, Leorke (B. Schramm Collection).

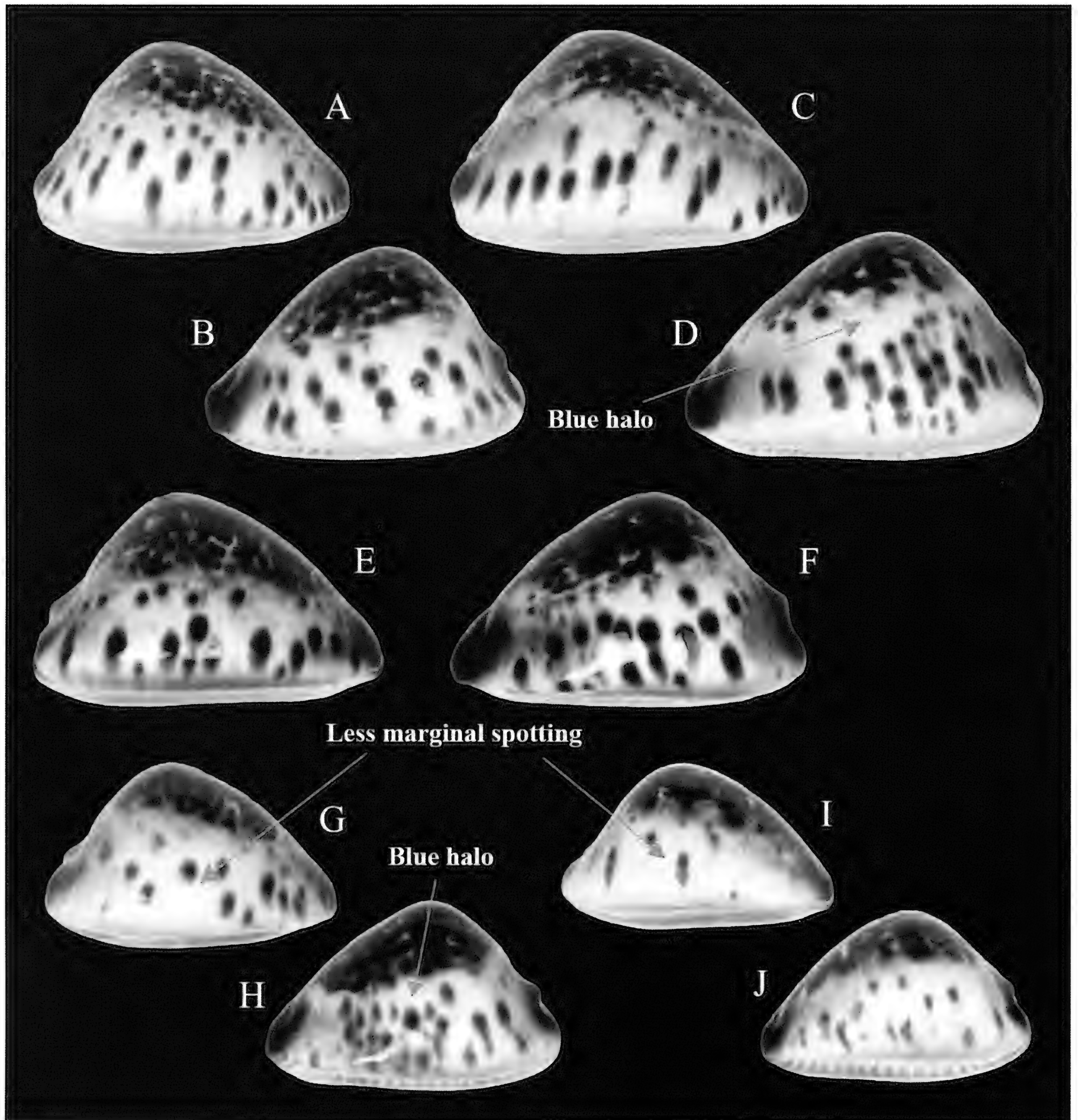
It appears that while the presence of one or more of the unique characteristics listed in Table 2 may be diagnostic for these species, having all of them in conjunction with appropriate location data may confirm the identity of your specimen. I welcome your comments and thoughts regarding other characteristics that you may be aware of to help others identify these species.





**Plate 1** compares the dorsum and base of *Z. e. eludens* (A-F) to *Z. e. delicatura* (G-J). The shape of *Z. e. delicatura* (G-I) is elongated and similar to the shape of *Z. decipiens* as compared to the broader ovate shape of *Z. e. eludens* (A-D). However, some *Z. e. eludens* can have a somewhat elongated shape (E-F) similar to *Z. e. delicatura*. The base markings of *Z. e. eludens* (B, D) show the desirable light orange cream to yellow cream base color while *Z. e. delicatura* typically have dark brown stripes and marginal spotting that extends onto the columellar side of the base (H, J). However, *Z. e. eludens* can also have similar base markings (F). The fossula of *Z. e. eludens* is easily visible through the shell's aperture (B, D & F), while the fossula in *Z. e. delicatura* is suppressed and not readily visible (H, J). In addition, the interior coloration of *Z. e. eludens* is a light-violet tan, while it is a deep purple in *Z. e. delicatura*.





**Plate 2** compares the side margins of *Z. e. eludens* (A-F) and *Z. e. delicatura* (G-J) showing the cream to off-white base color with dark brown to black spotting. The marginal spotting of *Z. e. eludens* is often dense (A-F), while there is often less spotting in *Z. e. delicatura* (G, I & J). However, *Z. e. delicatura* can also show dense marginal spotting as seen in H. The blue halo often observed at the boundary where the margin meets the dorsum common to *Z. e. eludens* can be seen in C, D & F. This is not common in *Z. e. delicatura*, but this species can show similar markings (H).



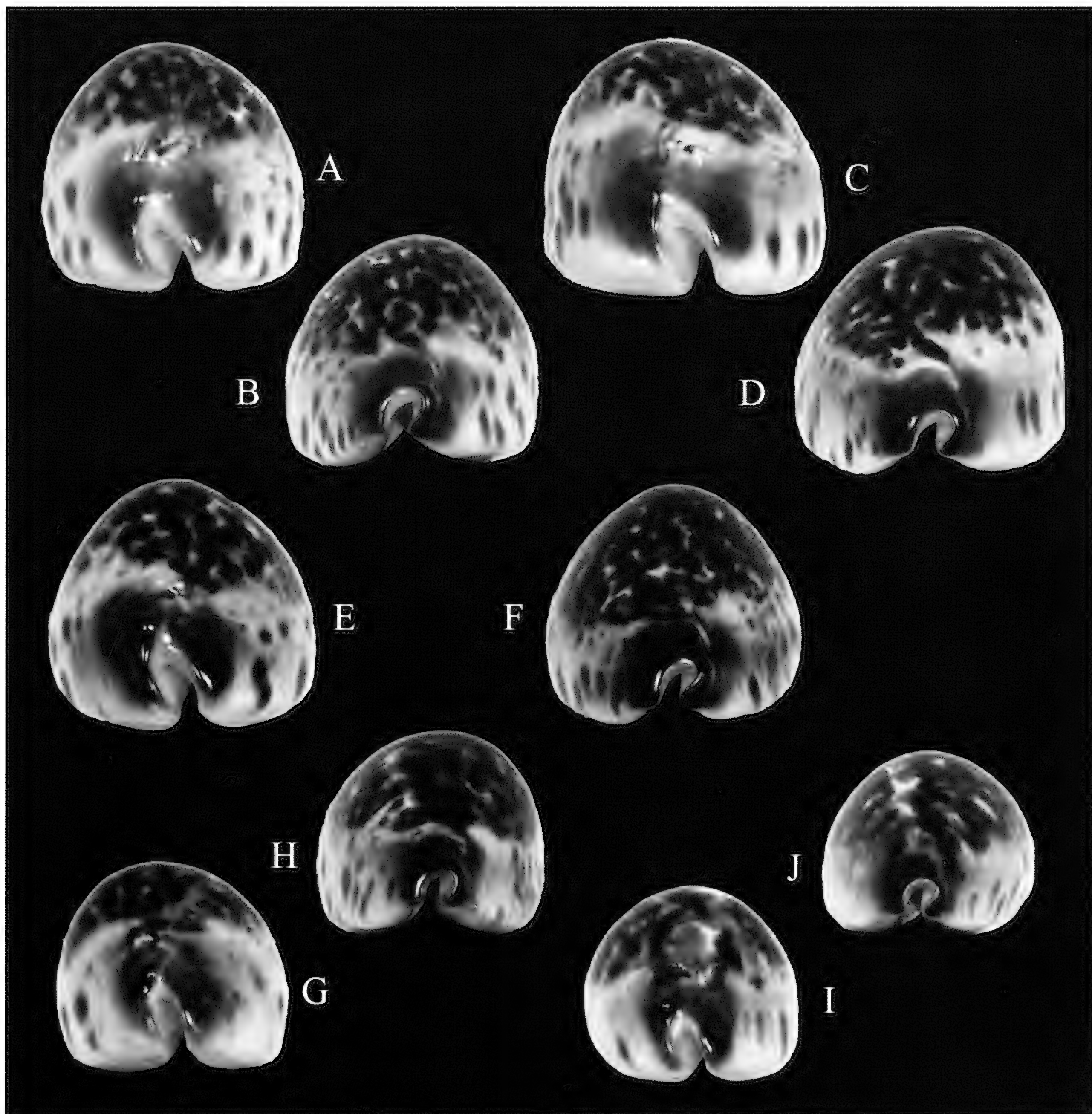


Plate 3 compares anterior and posterior ends of *Z. e. eludens* (A-F) and *Z. e. delicatura* (G-J).



## Exploring Crystal Cove State Park

Sonja Huc

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It was my first morning ever in San Diego and I was excited. I had my field clothes on, a windbreaker, and my camera bag. I rushed out to our rented car with my mother and husband in tow and we drove north for a good hour, until we reached the Pelican Point entrance of Crystal Cove State Park. In one of the parking lots, I met Lisa Lindahl, who was kind enough to offer to take my family to her favorite spot on the California coast for tide pool exploration, along with her grandson. We followed the trail to the beach and headed north, where the picturesque cliff meets the waves.

The very first gastropod I found, while starting to climb over the rocky outcropping was a gorgeous live Solander's Trivia (*Pusula solandri* (Gray, 1832)). I had never seen any live trivia before and it was interesting watching its foot go through the sand, likely searching for food.



Figure 1. *Pusula solandri* ~ Solander's Trivia



Figure 2. *Aplysia vaccaria* ~ Black Seahare

To avoid wading through deeper water, we climbed up the face of the cliff to a ridge that created a path to the next bay. In the ridge, about 2m above sea-level, there was a pool with some beautiful Hartweg's Chitons (*Cyanoplax hartwegii* (Carpenter, 1855)). This species of chiton has a fascinating blue tint on the interior of the valves, which I am not used to from shells of the Adriatic Sea back home. On the other side of the cliff, a breathtaking array of variously sized tide pools sprawled over the endless landscape. We had barely gone a few pools over, when Lisa found two Black Seahares (*Aplysia vaccaria* (Winkler, 1955)), each about the size of a football. I had seen naturalists find these on TV, but I never imagined I would be able to hold one so soon!

Walking past various Tegulas and Limpets, Lisa made perhaps one of the most exciting discoveries, a Green Abalone (*Haliotis fulgens* (Philippi, 1845))! With Haliotidae being my favorite mollusk family, I was over the moon. Lisa was also excited, since she hadn't found any in the last few years,



which indicates the population level may be rising in contrast to recent times, an indication that the various Abalone conservation efforts seem to be working. All together, we found seven specimens, all of them juveniles except for one adult which had been predated on by an otter, judging by the shape of the gaping hole in the shell. A few tide pools further along the coast we made another exhilarating find, three live Chestnut Cowries (*Neobernaya spadicea* (Swainson, 1823)), two of them about 25cm apart and a third only 1m away. We spent about 20 minutes carefully observing these incredible creatures, even taking videos of how gracefully they glide along the algae patches and slip tracelessly into the safety of the seaweed.



Figure 3. *Neobernaya spadicea* ~ Chestnut Cowrie

During the four hours we spent exploring the Californian coast, we observed over 50 different species. The table below contains the list of the mollusks I could relatively easily identify, but I am sure if I scrutinized the multitude of taken photos, I would be able to find some more chitons that I missed. We could also have used more thorough methods of searching, like sifting through the sand in tide pools. I did so for a few minutes and managed to find some adorable Pheasant and Margin shells, but to really get a sense of the local molluscan microfauna, we would need to really set our minds to it.

Table of species found in Crystal Cove, Orange County, CA, USA on November 10<sup>th</sup>, 2019.

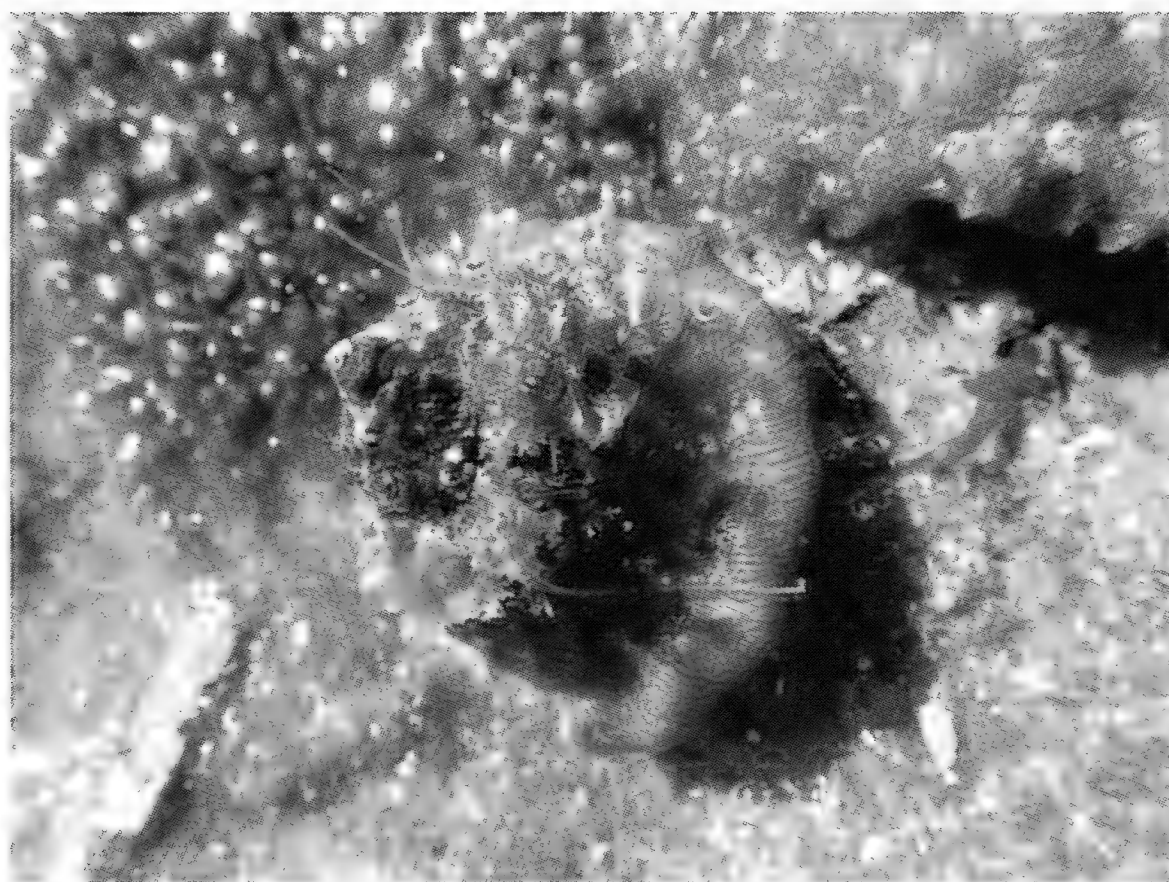
Bivalvia	Gastropoda
<i>Brachidontes adamsianus</i> (Dunker, 1857)	<i>Lottia fenestrata</i> (Reeve, 1855)
<i>Crassadoma gigantea</i> (J.E. Gray, 1825)	<i>Lottia gigantea</i> (Gray in G. B. Sowerby I, 1834)
<i>Epilucina californica</i> (Conrad, 1837)	<i>Lottia limatula</i> (Carpenter, 1864)
<i>Hiatella arctica</i> (Linnaeus, 1767)	<i>Lottia pelta</i> (Rathke, 1833)
<i>Kellia suborbicularis</i> (Montagu, 1803)	<i>Lottia scabra</i> (Gould, 1846)
<i>Limaria hemphilli</i> (Hertlein & A. M. Strong, 1946)	<i>Lottia scutum</i> (Rathke, 1833)
<i>Mytilus californianus</i> (Conrad, 1837)	<i>Macron lividus</i> (A. Adams, 1855)
<i>Pseudochama exogyra</i> (Conrad, 1837)	<i>Maxwellia gemma</i> (G. B. Sowerby II, 1879)
<i>Zemysina orbella</i> (Gould, 1851)	<i>Megastrea undosa</i> (W. Wood, 1828)
<b>Gastropoda</b>	<i>Neobernaya spadicea</i> (Swainson, 1823)
<i>Acanthinucella spirata</i> (Blainville, 1832)	<i>Norrisia norrisii</i> (G. B. Sowerby I, 1838)
<i>Alia carinata</i> (Hinds, 1844)	<i>Olivella biplicata</i> (Sowerby I, 1825)
<i>Amphissa versicolor</i> (Dall, 1871)	<i>Olivella biplicata</i> (Sowerby I, 1825)



<i>Aplysia vaccaria</i> (Winkler, 1955)	<i>Pseudopusula californiana</i> (Gray, 1827)
<i>Atrimitra idae</i> (Melvill, 1893)	<i>Pteropurpura festiva</i> (Hinds, 1844)
<i>Californiconus californicus</i> (Reeve, 1844)	<i>Pusula solandri</i> (Gray, 1832)
<i>Ceratostoma nuttalli</i> (Conrad, 1837)	<i>Roperia poulsoni</i> (Carpenter, 1864)
<i>Crepidula onyx</i> (G. B. Sowerby I, 1824)	<i>Tegula aureotincta</i> (Forbes, 1852)
<i>Crepidatella lingulata</i> (Gould, 1846)	<i>Tegula eiseni</i> (Jordan, 1936)
<i>Epitonium tinctum</i> (Carpenter, 1864)	<i>Tegula gallina</i> (Forbes, 1852)
<i>Eulithidium pulloides</i> (Carpenter, 1865)	<i>Tenaturris janira</i> (Dall, 1919)
<i>Fissurella volcano</i> (Reeve, 1849)	<i>Terebra pedroana</i> (Dall, 1908)
<i>Haliotis fulgens</i> (Philippi, 1845)	<i>Thylacodes squamigerus</i> (Carpenter, 1857)
<i>Hipponix antiquatus</i> (Linnaeus, 1767)	<i>Trimusculus reticulatus</i> (G. B. Sowerby I, 1835)
<i>Hipponix tumens</i> (Carpenter, 1864)	<i>Volvarina taeniolata</i> (Mörch, 1860)
<i>Lottia conus</i> (Test, 1945)	<b>Polyplacophora</b>
<i>Lottia digitalis</i> (Rathke, 1833)	<i>Cyanoplax hartwegii</i> (Carpenter, 1855)

**Table 1.** List of observed species.

The whole trip was a wonderful experience full of fascinating marine life. I come from Slovenia and used to live in North Carolina, so the Californian molluscan fauna is very different from what I am used to. It was so unusual to me that the Wavy Turban (*Megastraea undosa* (Wood, 1828)), which is such a large shell, is so common. The Festive Murex (*Pteropurpura festiva* (Hinds, 1844)) was also a pleasure to come across. This afternoon of exploration will forever be cherished in my mind and I am so thankful to Lisa for taking us to where her childhood happy place was!

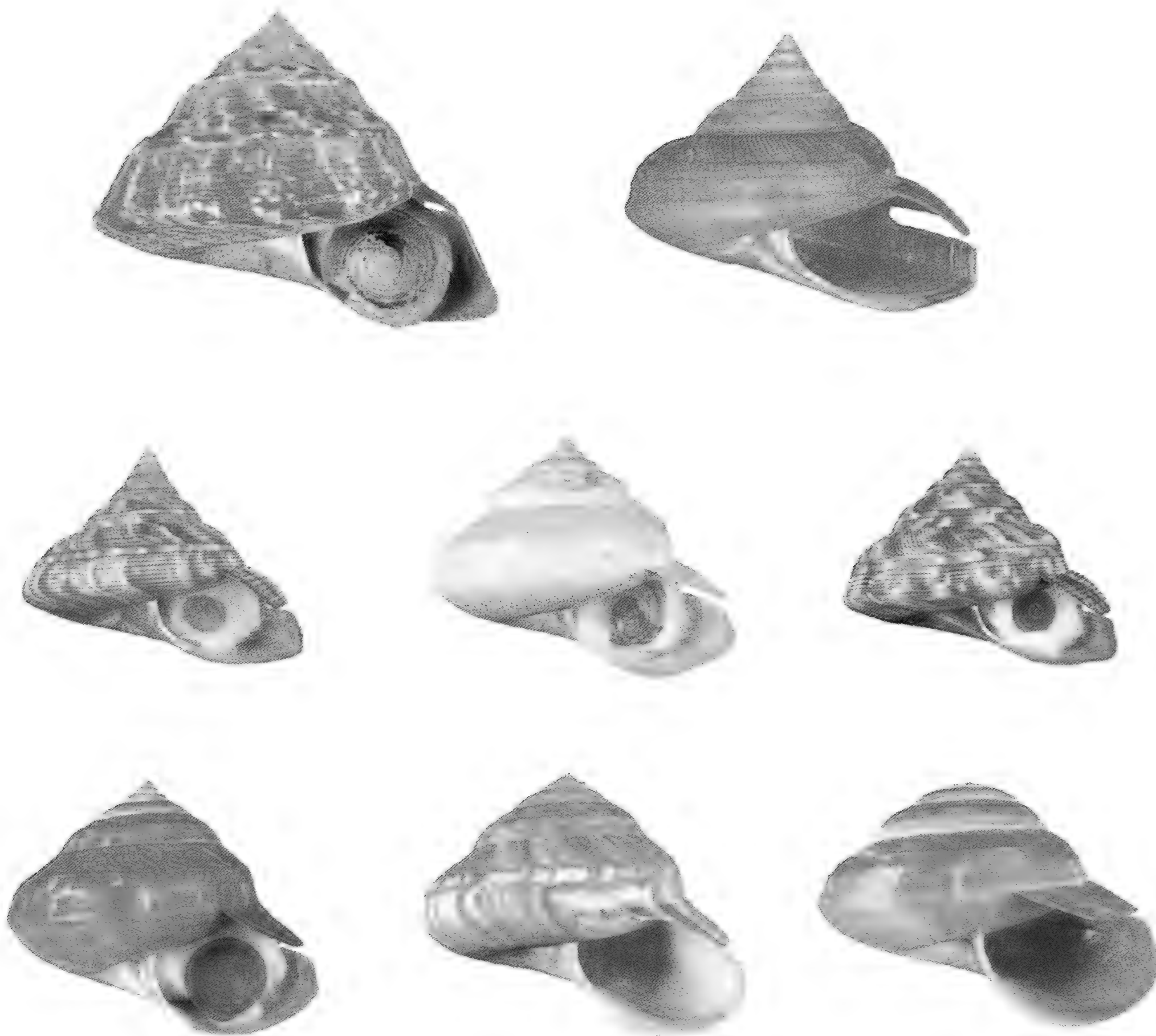


**Figure 4.** *Megastraea undosa* ~ Wavy Turban



**Figure 5.** *Pteropurpura festiva* ~ Festive Murex





*E. adansonianus adansonianus* (Crosse & Fischer, 1861), Bahamas, 106.1 mm. *B. poppei* (Anseeuw, 2003), Tonga Islands, 58.8 mm. *P. amabilis f. maureri* Harasewych & Askew, 1993, USA, 42 mm. *B. tangarona* (Bouchet & Métivier, 1982), New Zealand, 55.9 mm. *P. quoyanus* (Fischer & Bernardi, 1856), Curaçao, 50.7 mm. *B. philpoppei* Poppe, Anseeuw & Goto, 2006, Philippines, 65.1 mm. *B. charlestonensis* Askew, 1987, Martinique, 77.3 mm. *B. midas* (Bayer, 1965), Bahamas, 82.7 mm.

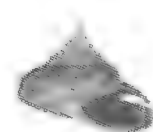
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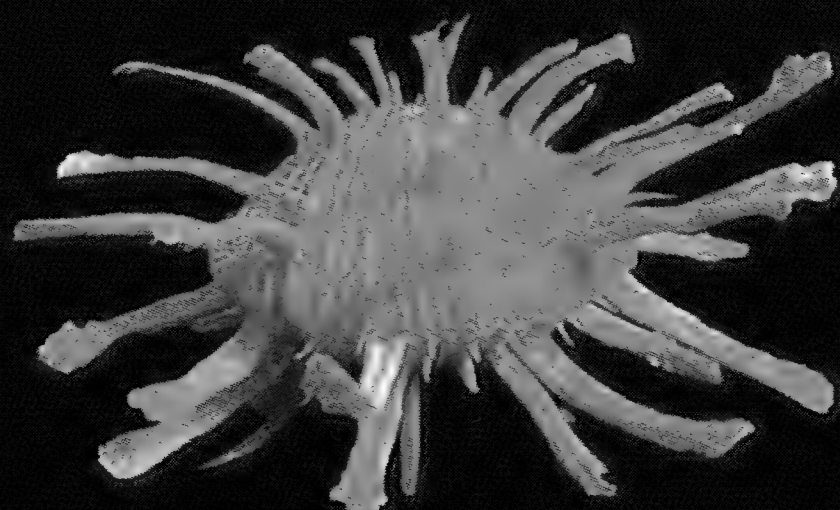




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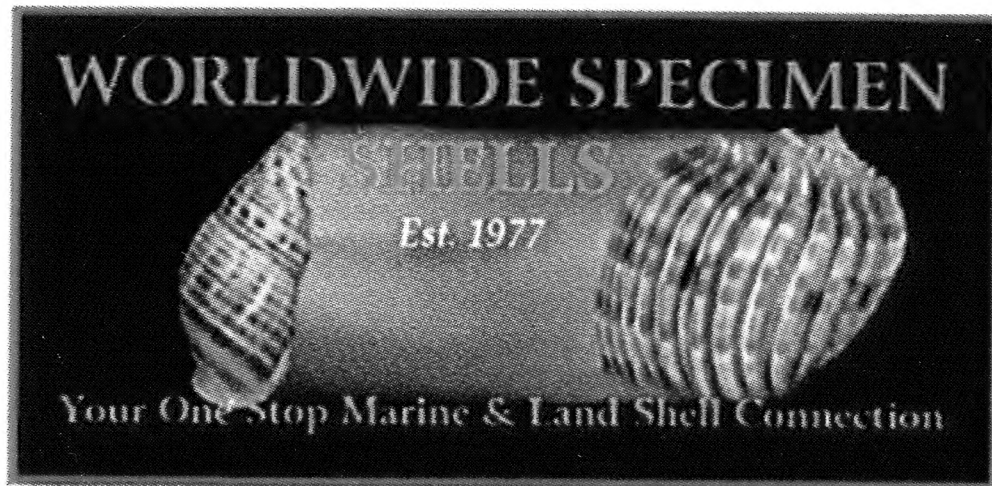
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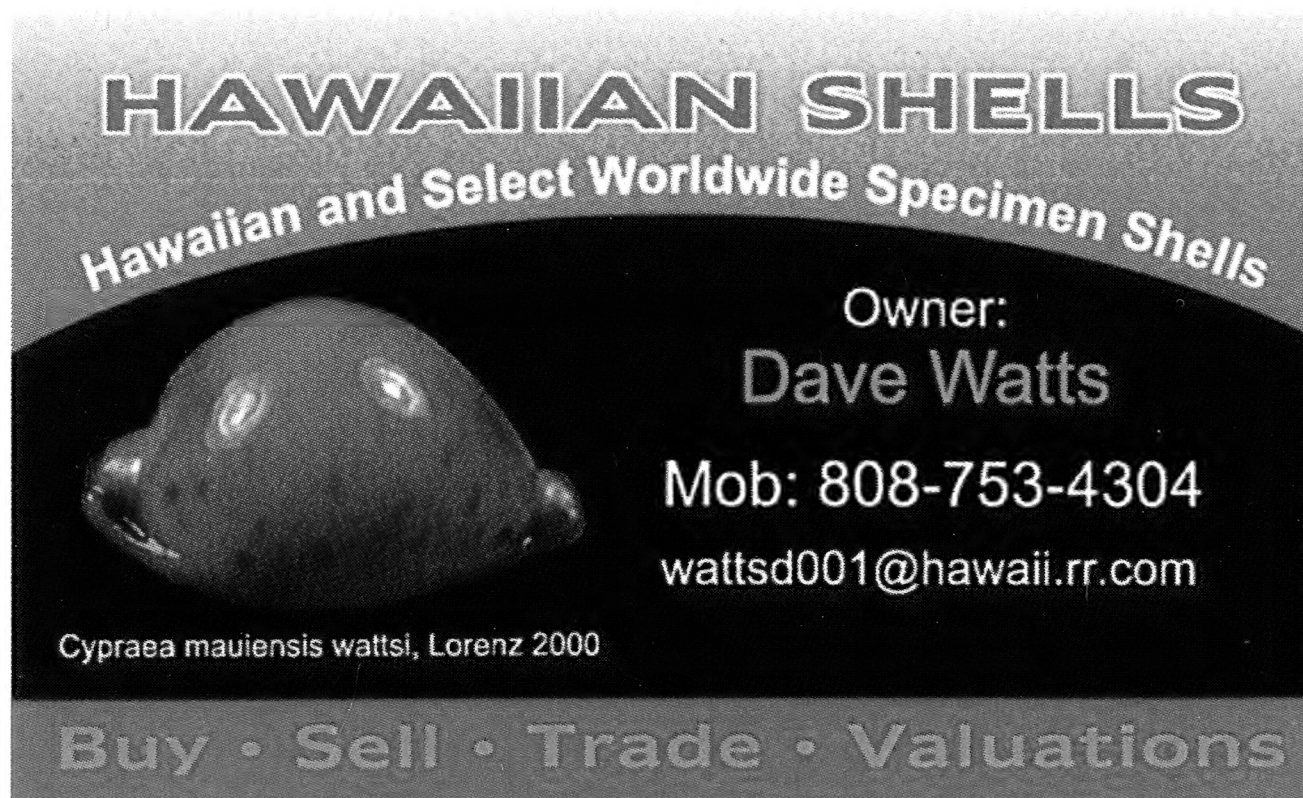
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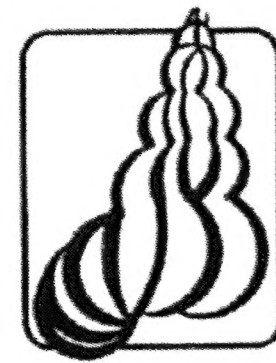
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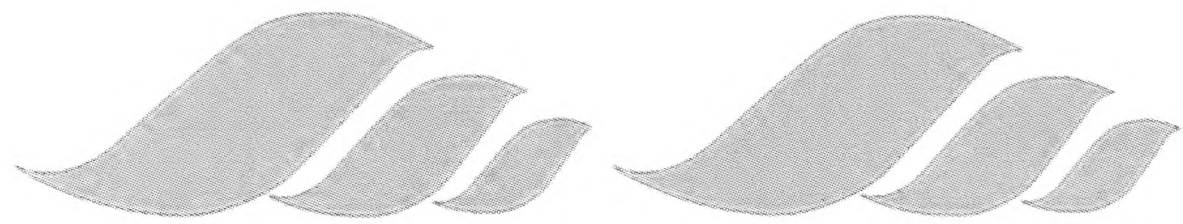
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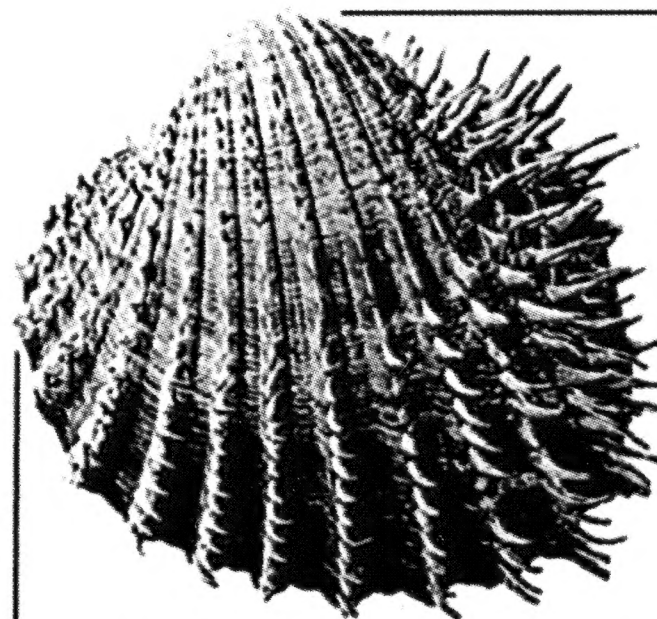
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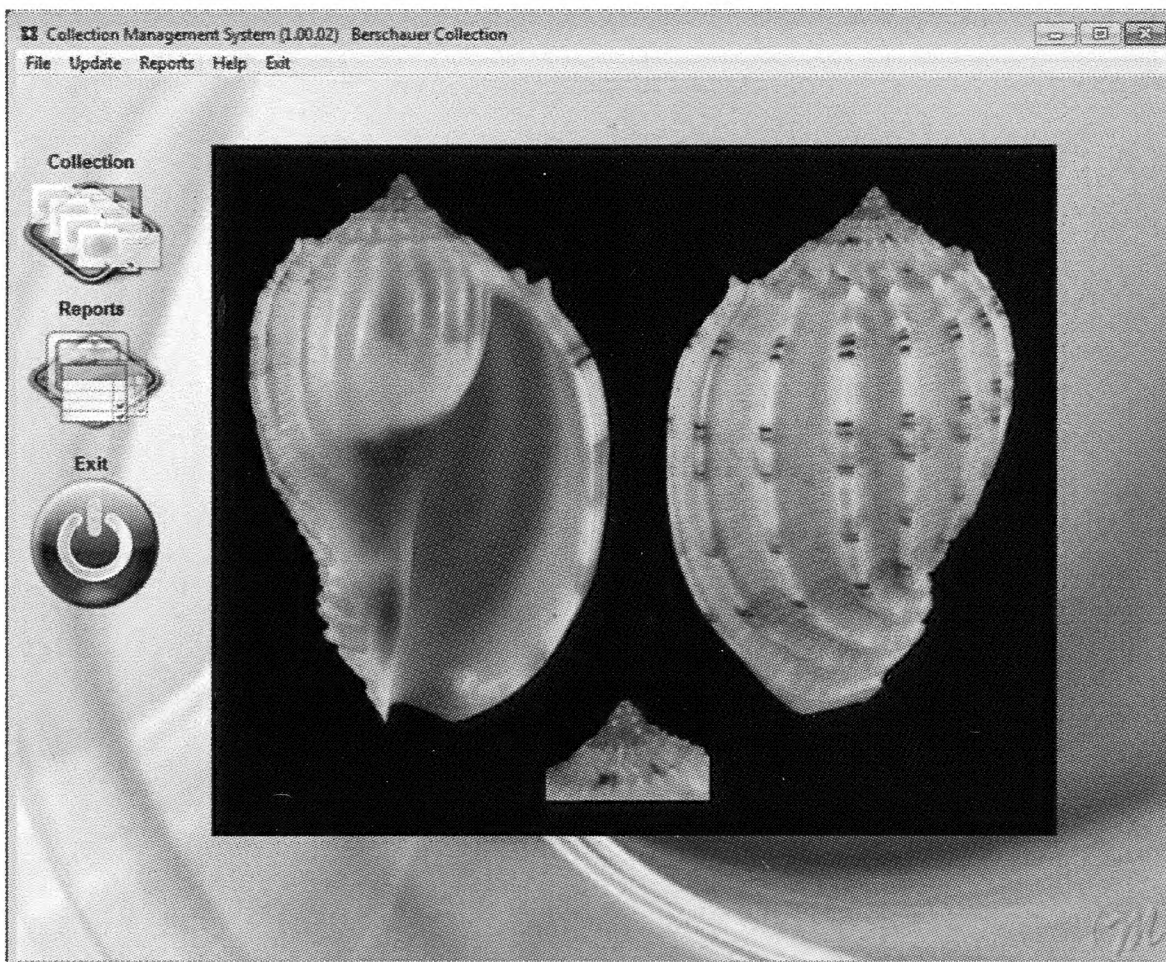
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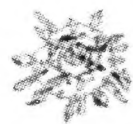


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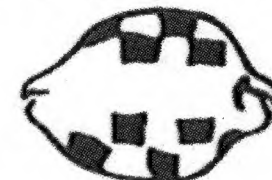
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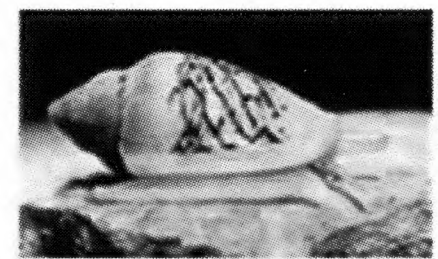
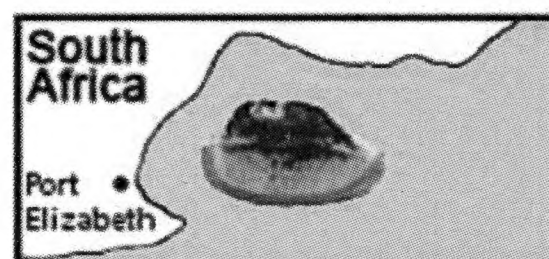
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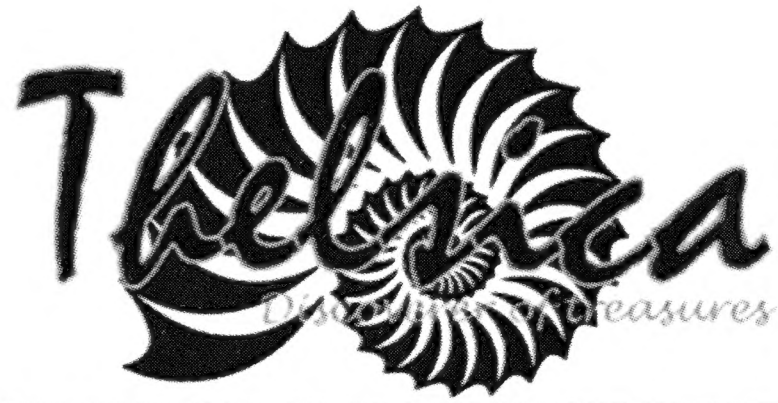
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**Back cover:** A pair of live *Neobernaya spadicea* (Swainson, 1823) in a tide pool in Crystal Cove State Beach Park, Orange County, California. Photo courtesy of Sonja Huc; used with permission. (Cover artistic credit: Rex Stilwill)



